

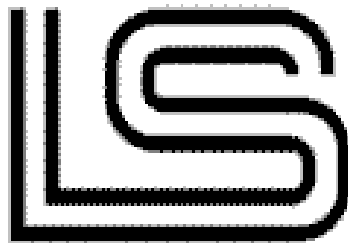
**INSTALLING, OPERATING AND MAINTAINING  
LAKE SHORE ELECTRIC CORPORATION**

**FIXED AND DRAW OUT**

**INSULATED CASE**

**AUTOMATIC TRANSFER SWITCHES**

**WITH MP 7600 CONTROLLER**



**LAKE SHORE ELECTRIC CORPORATION**

**205 WILLIS STREET \* BEDFORD, OH 44146  
Phone 440-232-0200 \* Fax 440-232-5644**



## **WARNING!**

WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER OF ELECTROCUTION EXISTS WHICH MAY RESULT IN INJURY OR DEATH. DO NOT ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT FIRST TAKING EVERY PRECAUTION TO PREVENT ACCIDENTAL INJURIES.

IN INSTALLATION AND USE OF THIS PRODUCT, COMPLY WITH THE NATIONAL ELECTRICAL CODE, FEDERAL, STATE AND LOCAL CODES, AND ALL APPLICABLE SAFETY CODES. IN ADDITION, TURN OFF POWER AND TAKE OTHER NECESSARY PRECAUTIONS TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE.

## **WARRANTY**

Lake Shore Electric Automatic Transfer Switches are guaranteed against defective materials and workmanship for a period of one year from date of shipment. If, within one year after shipment, it is proved to Lake Shore's satisfaction that the equipment does not meet the above warranty, and if Lake Shore is promptly notified of same, Lake Shore will make necessary corrections, free of charge, F.O.B. works where manufactured.

Such necessary corrections constitute the full extent of Lake Shore's warranty. There are no warranties, which extend beyond those described herein. This warranty is exclusive and is in lieu of all other warranties, whether written, oral, implied or statutory. No warranty of merchantability or of fitness for purpose shall apply.

Lake Shore is not responsible for damage to its equipment through improper installation or use, unauthorized repair or modifications, or attempts to operate it above its rated capacities or in abnormal environments. In no event, whether as a failure to meet conditions of the warranty or otherwise, shall Lake Shore be liable for any special, incidental, or consequential damages, including, but not limited to, loss of profit or revenues, loss of good will, damages to associated equipment, cost of capital, cost of substitute products, facilities, service or replacement power, costs of downtime or claims of third parties for such damages.

**Notice:** The owner of this automatic transfer switch must perform certain required maintenance functions as described in **Appendix A**, of this manual in order to maintain Lake Shore's one year exclusive warranty. Failure to perform this maintenance shall void this warranty.

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### NOTE

Engineering changes may have been made after publication date. Any departure from this manual should be checked with Lake Shore Electric Corporation.

Lake Shore Electric Corporation reserves the right to change specifications without prior notice.

## 1. CONSTRUCTION

Transfer Switches manufactured by Lake Shore Electric Corporation use insulated case switches and/or circuit breakers to accomplish the transfer of two separate power sources to a single load.

These insulated case switches and/or circuit breakers are electrically interlocked through the MP7600 Controller and auxiliary switches, and are mechanically interlocked. The mechanical interlock is located on the right side of the two switches. This mechanism is a factory-installed device, which positively prevents both of the insulated case switches or circuit breakers from being in the **ON** position simultaneously. This redundant interlocking system provides a "Fail-Safe" design. **Note:** This mechanical interlock is not provided on units equipped with the Closed Transition Transfer Option.

Manually operable push buttons are accessible from the front of the switch to enable personnel to manually operate the transfer switch should this become necessary. These pushbuttons are permanently mounted and readily accessible in an emergency. Please note that the operator is able to manually operate the transfer switch under load.

All interface relays are of the enclosed industrial type to ensure long life and minimum maintenance. All relays are rated for continuous duty to eliminate overheating of coils. The MP7600 Controller, which is the heart of our control system, is a rugged, durable industrial quality device that assures minimum maintenance.

All timers including the plant exerciser are incorporated in the microprocessor control. All timer values are stored in non-volatile memory.

Wiring harnesses are manufactured from 16-gauge insulated machine tool wire. The transfer motor control circuits are protected with miniature overload circuit breakers.

## 2. DESCRIPTION OF OPERATION

The following are general descriptions of operation applying to Insulated Case Transfer Switches. Certain accessory additions may modify the sequence of operations as required to suit specific applications

The Insulated Case Automatic Transfer Switch utilizes the internal motor of each of the normal and emergency switches for its operation. Normally, the transfer switch operates on the preferred power source with the normal switch in the closed position and the emergency switch in the open position.

All phases of the preferred power source are continuously monitored by a voltage sensitive relay, which is adjustable from 70% to 100% of the nominal voltage. In the event of a drop in any phase of the preferred voltage below the dropout set point, the voltage relay sends a signal to the MP 7600 Microprocessor controller. The MP 7600 in turn initiates a Time Delay Engine Start (TDES) timer. Upon completion of the TDES, a signal is given via a dry "form C" contact to the engine start circuit, and the Minimum Run Timer (MRT) is initiated. After the engine has started and develops frequency and voltage, the frequency voltage relay will send a signal to initiate a Time Delay Emergency (TDE) timer. Upon completion of the TDE, the normal source switch will be opened thus placing the transfer switch in the neutral position.

Upon opening of the normal side a Time Delay Neutral (TDN) is initiated which when timed out, allows for the closing of the emergency switch thus connecting the alternate source to the load. With the Automatic Transfer Switch now operating on the emergency source, the voltage relay continues to monitor the normal source.

Upon restoration of normal power as sensed by the voltage relay, a Time Delay Return (TDR) is initiated. Upon completion of the TDR, the switch will retransfer the source from emergency by opening the emergency switch, initiating the TDN and which it times out close the normal switch. After retransfer to normal a Time Delay Engine Cool down (TDEC) timer is initiated. Upon completion of the TDEC and upon the completion of the MRT, the engine start signal will be removed.

Note: On transfer switches built for Utility-to-Utility applications, the sequence of operation does not include the Time Delay Engine Start (TDES), Time Delay Engine Cool Down (TDEC) and Minimum Run Timer (MRT). Otherwise the operation is the same as described above.

For those Transfer Switches built as Draw Out switches, additional safety and reliability is provided. The transfer switch itself inherently functions to bypass either source by connecting the alternate source to the load. By offering the draw out feature, either or both of the insulated case switches can be withdrawn, thereby isolating them from live parts. This allows maintenance, service or replacement of the switch without loss of service to the load or danger to the maintenance personnel. Please refer to chapter 5 for detailed instruction on the operation of these insulated case products.

Note: When draw out transfer switches are placed in the test position, they are considered to be "not in automatic" notwithstanding the HMI display of the Mode of Operation. See 4.2 Switches.

The Insulated Case Automatic Transfer Switch is effectively used for Service Entrance Rated Transfer Switches because the independent motor design allows the necessary condition of having both switches in the off position so that the load is isolated and disconnected from the two sources.

The Insulated Case Automatic Transfer Switch is also effectively used for Closed Transition Transfer Switches because the independent motor design allows the necessary condition of having both switches in the on position so that the load is momentarily connected to both sources when they are synchronized providing a "make before break" transfer.

### **3. INSTALLATION**

#### **3.1 MOUNTING AND CONNECTING**

The standard Lake Shore transfer switch is designed for operation in a clean, dry, dust-free location where a minimum of vibration is present.

When used in conjunction with an engine generator set, it is recommended that the transfer switch be located as close as possible to the generator set, as this will reduce the length of the DC control wiring (required for automatic operation) thus preventing voltage drops and improper operation. The maximum recommended distance the automatic transfer switch

should be installed from the engine generator set is 1400 feet.

IC Transfer Switches are designed for free standing enclosure mounting. Open transfer switches are generally mounted in a customer-supplied enclosure; consequently, there are certain steps, which should be followed:

1. Allow adequate space for placement of the control panel and HMI.
2. Mount to a rigid framework to prevent vibration.
3. Review all electrical clearances with the enclosure door or panels closed.
4. Insure there is no strain on the bus bars due to improper alignment.
5. Lug size and arrangements may vary depending on project requirements. Optional lug arrangements are available, but must be specified at the time the transfer switch is ordered. Consult Lake Shore Electric for details.

Before bringing the power cables into the enclosure, be certain that the lugs will be of the correct size. If not, different sizes may be ordered from Lake Shore Electric.

The Normal source power cables are connected to the Normal Bus extensions marked NL1, NL2, and NL3. Please refer to the specific wiring diagram supplied with the switch.

The Emergency source power cables are connected in a like manner to the Emergency bus extensions marked EL1, EL2 and EL3. (**Note:** Be careful to pass the cable through any current transformers or other devices, which may be part of a generator control.) The load cables are connected to the load bus extensions marked L1, L2 and L3. On three-phase, four-wire transfer switches, or single-phase, three-wire transfer switch, a neutral bus is provided. **Note:** Verify that phase sequence rotation of normal and emergency sources are identical. Failure to do this will result in damage to the transfer switch and other equipment and will void the warranty extended by Lake Shore Electric Corporation. When installing the power cables, be careful not to disturb or damage the control wires that go to the various terminals. A ground lug is provided on all transfer switches. This lug **must** be connected to earth ground.

**CAUTION:** Be sure to check that all power cable lugs are torqued to the applicable requirement for the switch (see Appendix A).

Connect DC voltage source and start contacts. Please refer to page 13 MP7600 installation.

There are numerous accessories available on Lake Shore transfer switches, which require external connections. Refer to the wiring diagram included with your transfer switch for specific instructions on connecting these accessories.

### **3.2 PLACING THE TRANSFER SWITCH IN OPERATION**

Before energizing the switch electrically, be certain all external connections have been properly made according to the wiring diagram provided with the switch. Inspect all wires, cables, and bus bar for abraded insulation, foreign matter, and electrical clearance.

Manually set the transfer switch to the Normal source (Normal breaker **Closed** and Emergency Breaker **Open**) and energize the normal source. The red LED on the Voltage Sensing Relay should be lighted, indicating that the normal source is available and within the pick-up setting

of the relay. If this does not light (i.e. pick up), place a voltmeter on the normal source to be sure that the voltage is adequate and within the range of the relay. The switch will not operate on a voltage other than that stamped on the nameplate of the transfer switch.

Do not attempt to energize the Emergency source until the switch is operating satisfactorily on normal. With the Normal source operating, the Emergency source may now be **manually** energized for testing. The Emergency source, including all safety interlocks, should be checked over before an attempt is made at a complete automatic systems test. When the Emergency source has been tested satisfactorily and de-energized, a test of the automatic system can now be tried.

All MP7600 controlled Transfer Switches have a "Load Test" operational mode which is menu selectable at the HMI panel. A test of the automatic circuitry can be initiated by placing the Transfer Switch in the load test mode. This will cause the normal control circuits to de-energize and give a signal to start the engine. After the generator is up to voltage and frequency, the transfer switch will transfer to the emergency source.

Now return the operation mode to "Auto" at the HMI panel. The transfer switch should, after the appropriate time delays, return to normal if normal power is available. Now depress the momentary Load Test Cycle pushbutton inside the door. The transfer switch should simulate a power failure and transfer to emergency and return to normal after the appropriate time delays.

The above tests are sufficient to place the transfer switch in operation. The following pages contain specific information on the various components and troubleshooting information.

## **4. CONTROLLER MP 7600**

### **4.1 INTRODUCTION**

The LSEC MP7600 is a sophisticated state of the art, microprocessor based controller. It consists of four major parts: a Power Supply board, a Relay Interface Board, a Main Control Board and a Human Machine Interface Panel. It is designed to operate in the "industrial" temperature range of -40 to +85 deg C.

#### **Power Supply** (Figure 1)

The Power Supply (PS) unit accepts a 12-volt dc or 24-volt dc input from automotive quality, or better power source. It is designed to function on starting batteries. Voltage regulation for the power supply is within 2% volts from no load to full load. External voltage sources can vary from 7 volts dc to 36 volts dc without harm to the MP7600 or interruption of its operation. Momentary losses of power will not compromise the efficient operation of the controller. This is a negative ground system. The board has provision to accommodate a large external "hold-up" capacitor for installations that may experience momentary input-voltage dropouts or reversals. For more information on the use of a capacitor in this circuit, please contact the factory for necessary components and proper application.

TB1

1 Input Positive



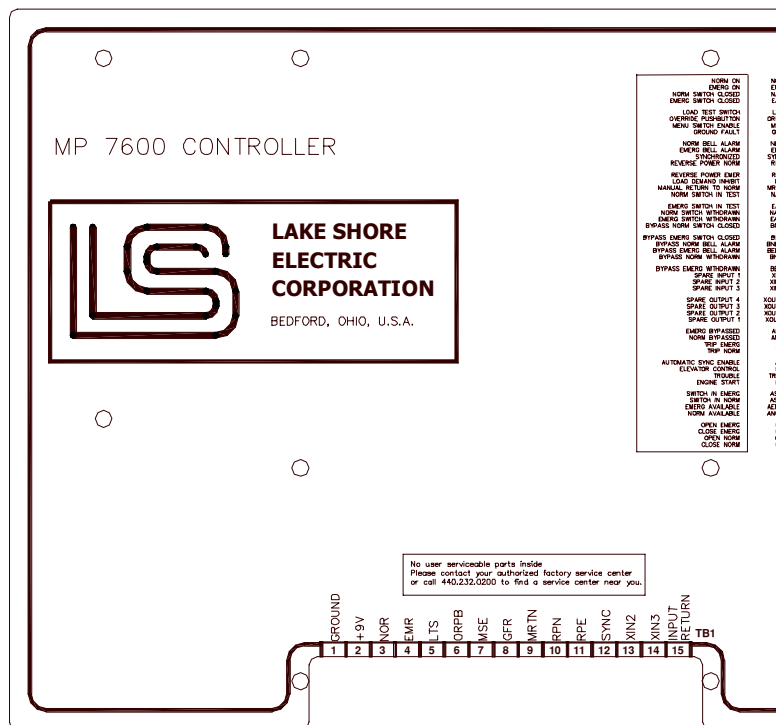
## Main Control Board (Figure 3)

The Main Control Board (MCB) contains the microprocessor and performs all of the logic necessary to control the transfer switch. It contains a perpetual date and time clock, which is programmed to automatically adjust for leap years. It contains the timers listed in the section marked "Setting Timers". All timers, date and time settings are stored in battery backed-up non-volatile memory, which can be maintained de-energized for 10 out of 100 years.

There are no user serviceable components in the MCB; however, there are connections that need to be made to it. All of these connections will be made at the factory.

### TB1

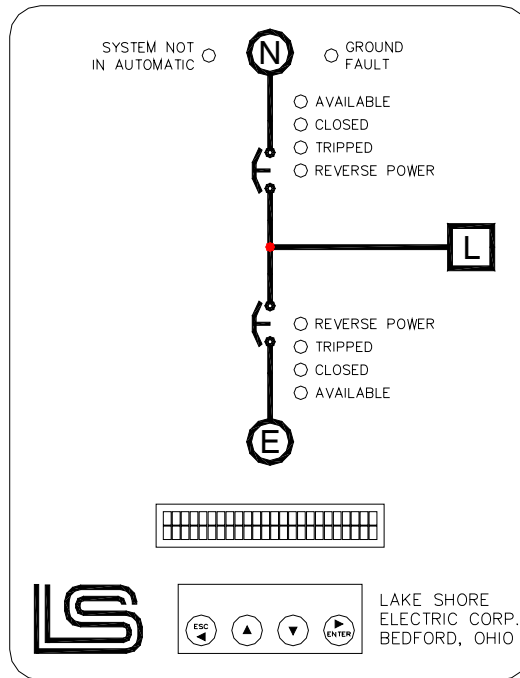
1	Ground	Power supply grounded Negative	9	PS	Peak Shaving
2	+9V	Power supply Positive	10	RPN	Reverse Power Normal
3	NOR	Normal Power Available	11	RPE	Reverse Power Emergency
4	EMR	Emergency Power Available	12	SYNC	Synchronizing
5	LTS	Load Test Switch	13	XIN2	Spare
6	ORPB	Override Push Button	14	XIN3	Spare
7	MSE	Menu System Enable	15	Input	Return
8	GFR	Ground Fault Relay			



(Figure 3)

### Human Machine Interface Panel (Figure 4)

The Human Machine Interface Panel consists of a graphic overlay which displays a one-line representation of a transfer switch, various LED's to annunciate status of the switch, a two line, 40 character LCD to display transfer switch mode of operation, date, time, timers status, fault condition, exerciser status other pertinent data. Additionally, the HMI Panel contains a keypad, which allows the transfer switch to be programmed.



(Figure 4)

## 4.2 OPERATIONAL CONFIGURATION

The MP7600 controls the operation of the automatic transfer switch and contains as standard features five modes of operation, up to nine timers, a plant exerciser, and various sets of dry contacts for customer use.

### Modes of Operation (Utility to Generator)

There are five modes of operation. Four of which are selectable by using the HMI Panel

1. Automatic
2. Hand Crank
3. Load Test

#### 4. Off/Reset

The fifth mode is Fault. In the fault mode, the transfer switch has failed to perform some function and the fault is displayed on the HMI Panel LCD. The eight types of fault that will be displayed are:

1. Ground Fault\*
2. Reverse Power\*
3. Bell Alarm (normal or emergency)\*
4. Open Normal Failed
5. Open Emergency Failed
6. Both Opens Failed
7. Close Normal Failed
8. Close Emergency Failed

\* Optional Equipment

#### **Modes of Operation (Utility to Utility)**

There are four modes of operation for this configuration. Three of which are selectable by using the HMI Panel

1. Automatic – U1 Preferred
2. Automatic – U2 Preferred
3. Off/Reset
4. Fault

The fourth mode is Fault and will be displayed as shown above.

#### **Timers (Utility to Generator)**

Up to eight timers are available:

- |      |   |
|------|---|
| TDES | Time Delay Engine Start. This timer is adjustable from 0 to 300 seconds and is factory set at 3 seconds. It is initiated upon sensing the loss of normal power and once timed out will initiate an engine start signal.   |
| TDE  | Time Delay Emergency. This timer is adjustable from 0 to 300 seconds and is factory set at 3 seconds. It is initiated upon the sensing of the emergency source and once timed out will initiate the transfer to the emergency source.   |
| TDN  | Time Delay Neutral. This timer is adjustable from 0 to 300 seconds and is factory set at 3 seconds. It is initiated upon the opening of one source and will inhibit the closing of the oncoming source until it has timed out.  |
| TDR  | Time Delay Return. This timer is adjustable from 0.0 to 60.0 minutes and is factory set at 12 minutes. It is initiated upon the restoration of normal power and will inhibit the switch from retransferring to the normal source until it has timed out. If at any time during the timing cycle normal power is not maintained, this timer will be terminated and will be reinitiated when normal |

power returns.

- TDEC Time Delay Engine Cool down. This timer is adjustable from 0.0 to 60.0 minutes and is factory set at 10 minutes. This timer is initiated upon the retransfer of the switch to the normal source and will keep the engine running until it has timed out.
- MRT Minimum Run Timer. This timer is adjustable from 0.0 to 60.0 minutes and factory set at 10 minutes. It is initiated upon the initiation of starting the engine generator set and will keep the engine running until it has timed out.
- SFT\* Synchronize Fail Timer. This timer is adjustable from 0.0 to 60.0 minutes and is factory set at 15 minutes. It is only used for closed transition transfer switches. It is initiated at the time that actual transfer is permitted by the controller. If it times out prior to a transfer being complete, it will display "Trouble: SFT timed out", but will not terminate operation of the transfer switch.
- TDBT\* Time Delay Before Transfer. This timer is adjustable from 0 to 300 seconds and is factory set at 10 seconds. It is initiated when the switch is ready to transfer and upon its completion the transfer will take place. This is typically used in elevator circuits.

\* Optional Equipment

### **Timers (Utility to Utility)**

Up to eight timers are available:

- TDE Time Delay Emergency. This timer is adjustable from 0 to 300 seconds and is factory set at 3 seconds. It is initiated upon the sensing of the emergency source and once timed out will initiate the transfer to the emergency source.
- TDN Time Delay Neutral. This timer is adjustable from 0 to 300 seconds and is factory set at 3 seconds. It is initiated upon the opening of one source and will inhibit the closing of the oncoming source until it has timed out.
- TDR Time Delay Return. This timer is adjustable from 0.0 to 60.0 minutes and is factory set at 12 minutes. It is initiated upon the restoration of normal power and will inhibit the switch from retransferring to the normal source until it has timed out. If at any time during the timing cycle normal power is not maintained, this timer will be terminated and will be reinitiated when normal power returns.
- SFT\* Synchronize Fail Timer. This timer is adjustable from 0.0 to 60.0 minutes and is factory set at 15 minutes. It is only used for closed transition transfer switches. It is initiated at the time that actual transfer is permitted by the controller. If it times out prior to a transfer being complete, it will display "Trouble: SFT timed out", but will not terminate operation of the transfer switch.

TDBT\* Time Delay Before Transfer. This timer is adjustable from 0 to 300 seconds and is factory set at 10 seconds. It is initiated when the switch is ready to transfer and upon its completion the transfer will take place. This is typically used in elevator circuits.

\* Optional Equipment

### **Plant Exerciser.**

The Plant Exerciser operates on a weekly basis and operates as follows:

1. It can be disabled
2. It can be enabled with or without load
3. Any time of day can be selectable as start time
4. Any duration of exercise period is selectable (hh:mm) from 00:01 through 24:00
5. Any day or days of the week (SMTWTFSS) are selectable for exercising.

### **Dry Contacts.**

Dry contacts are provided for:

1. One set of "form C" contacts to initiate engine start \*\*
2. Two sets of "form C" contacts for remote "Switch in Emergency" indication
3. Two sets of "form C" contacts for remote "Switch in Normal" indication
4. Two sets of "form C" contacts for remote "Emergency Available" indication \*
5. Two sets of "form C" contacts for remote "Normal Available" indication \*
6. Two sets of "form C" contacts for remote "Trouble Indication" indication
7. Two sets of "form C" contacts for remote "Transfer Pre-signal" initiation \*

\* Optional Equipment

\*\* Not included on Utility to Utility switches

### **Switches**

Transfer switches are provided with four standard switches mounted internally:

1. Maintenance disconnect switch – which disconnects ac and dc power from the control circuit to allow for service and maintenance of the controls.
2. Load Test Switch – which provides for a complete load test cycle with load. When depressed the transfer switch will perform a complete transfer to emergency and return to normal after operation of all applicable timers. **NOTE:** When the switches are withdrawn to the test position, the "not in automatic" light will flash and the load test switch will be inoperative.
3. Keypad enable switch – which will enable or disable the HMI keypad. When disabled, the HMI will display "Keypad Disabled" when any key is depressed.
4. Override TDR Switch – which will override the time delay imposed by the TDR timer.

### 4.3 INSTALLATION

Installation of the MP7600 Controller is straightforward and easy. Please follow the steps below and consult the drawings provided with the transfer switch.

#### Wiring

1. Verify that the external voltage source to the transfer switch is compatible with the relays supplied on the Relay Interface Board (i.e. either 12 vdc or 24 vdc).
2. Connect your external power source (12 or 24 volts dc) to the customer interconnect terminal block terminals 011 (Positive) and 010 (Negative).
3. Connect the two wires to the engine start circuit to Relay Interface Board ES contacts. Use C and NO for energize to run.

#### Setting Date & Time

At the LCD display on the front of the switch (see Figure 4) depress the "Enter" pad. The LCD will display "Main Menu/Select Mode". Depress "↓" and the LCD will display "Main Menu/Set Current Time & Date". Depress "Enter" this will select that you wish to set the current time and/or date. The LCD will now display the current time and date. A single character will be underlined. To increase or decrease its value, depress either "↓" or "↑" until the value you desire is displayed. When the correct value is displayed depress "Enter" and that value will be accepted. The curser will advance to the next character and the same value selection procedure should be followed until the correct time and date have been entered into the non-volatile memory.

At any time throughout programming the "ESC" pad may be pressed to return to the previous screen without accepting any new values.

#### Setting Timers

At the LCD display on the front of the switch (see Figure 4) depress the "Enter" pad. The LCD will display "Main Menu/Select Mode". Depress "↓" twice and the LCD will display "Main Menu/Set Timers".

Depress "Enter" this will select that you wish to set any or all of the timers. The LCD will now display "SET UP TIMERS/Select Timer: TDES". If you do not wish to change the TDES timer, depress "↓" and the display will advance to the next timer.

If you wish to change the TDES timer, depress "Enter". The LCD will now display "SET UP TIMERS/Set Time TDES: XXX sec". Notice the first digit of the available time range will be underlined. If you wish to increase or decrease its value, depress either "↓" or "↑" until the value you desire is displayed. When the correct value is displayed depress "Enter" and that value will be accepted.

The LCD will sequence through all the timers in the same manner. Depress either "↓" or "↑" to

select the timer you which to change and then depress "Enter". Always complete any timer change by depressing the "Enter" pad. Failure to do so will not enter the value you wish to store in memory.

Timer settings can be reviewed by going through the SET UP TIMERS routine.

### **Setting Plant Exerciser**

At the LCD display on the front of the switch (see Figure 4) depress the "Enter" pad. The LCD will display "Main Menu/Select Mode". Depress "↓" three times and the LCD will display "Main Menu/Set Up Plant Exerciser". Depress "Enter" and the LCD will display "SET UP EXERCISER/Load? Yes : Start: XX:XX".

Notice the first Letter of "Yes/ or No" will be underlined. If you wish to change from Yes to No or visa versa, depress either "↓" or "↑" until the value you desire is displayed. Then depress "Enter", this will advance the underlined text to the first digit of the start time (XX:XX). If you wish to increase or decrease its value, depress either "↓" or "↑" until the value you desire is displayed. When the correct value is displayed depress "Enter" and that value will be accepted.

The LCD will now display "SET UP EXERCISER/Duration (hh:mm): XX:XX". Notice that the first digit of the hour and minute duration timer is underlined. If you wish to increase or decrease its value, depress either "↓" or "↑" until the value you desire is displayed. When the correct value is displayed depress "Enter" and that value will be accepted. Continue until the LCD then displays "SET UP EXERCISER/Days (Caps = ON) : s m t w t f s". Notice that the first character will be underlined. If you depress either "↓" or "↑", the underlined letter will change case. Upper case means that the day selected will perform an exercise.

Note: If no days are selected (i.e. left in lower case), the exerciser will be disabled. This will be displayed in the operational display as "DO NOT EXERCISE".

### **Setting Mode of Operation**

At the LCD display on the front of the switch (see Figure 4) depress the "Enter" pad. The LCD will display "Main Menu/Select Mode". Depress "Enter" and the LCD will display "MODE SELECT/Automatic". If you do not wish to select "Automatic", depress "↓" and the display will advance to the next mode of operation.

If you wish to select "Automatic" as the mode of operation depress "Enter". The display will return to the operating position.

### **Operational Display**

When not in programming mode the LCD on the HMI panel will display (Operational Display) the mode selected, the status of the exerciser, time and date. Figure 5 shows a standard display of the controller in the automatic position with a programmed load test exerciser period. Also displayed is the time and date.

<p><b>AUTO – EXERCISE W/LOAD</b> <b>08:22 Fri OCT 4, 2002</b></p>
---

(Figure 5)

Whenever the controller requires any action, the LCD displays the status of each timer. Figure 6 shows a standard display of the controller waiting for the TDES to time out before the engine is started.

**AUTO – EXERCISE W/LOAD**  
**Awaiting TDES: 3 sec**

(Figure 6)

Whenever there is a fault, the operation of the switch is terminated and the LCD displays the appropriate error message. Figure 7 shows a standard display of the controller displaying a Close Normal Failed fault.

**FAULT – Close NOR failed**  
**08:24 Fri OCT 4, 2002**

(Figure 7)

## 5. INSULATED CASE SWITCHES

The operating or switching mechanisms used in the Insulated Case Automatic Transfer switches are MASTERPACT® MP automatic and non-automatic circuit breakers. The MASTERPACT® devices may be non-automatic, automatic, fixed or draw-out as required by the transfer switch configuration. This insert provides necessary technical information on these products. If additional information is necessary, please contact the factory.

### MASTERPACT® MP, MF and MC Circuit Breakers



## HANDLING

### MP08 to MP30 and MC08 to MC20 Circuit Breakers

**⚠ DANGER**

**HAZARD OF CIRCUIT BREAKER FALLING**

- Be sure equipment has adequate lifting capacity for the unit being lifted.
- Follow manufacturer's instructions for use of lifting equipment.
- Wear hard hat, safety shoes and heavy gloves.

**Failure to follow this instruction will result in death or serious injury.**

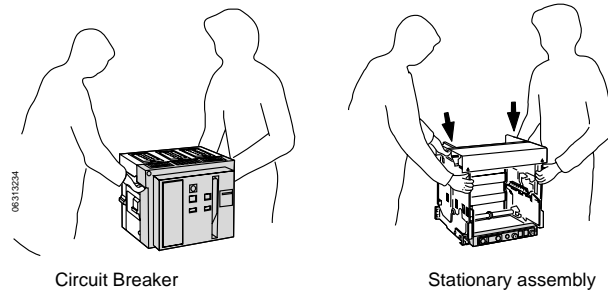
Both the circuit breaker frame and stationary assembly have notched lifting flanges for lifting. To reduce the total weight and ease installation of the stationary assembly, remove the circuit breaker from the stationary assembly (refer to **Disconnecting Instructions**, page 20). To lift the circuit breaker using a lifting device, use an overhead lifting device attached to the lifting flanges.

**Table 1: 3-pole Circuit Breaker Weights**

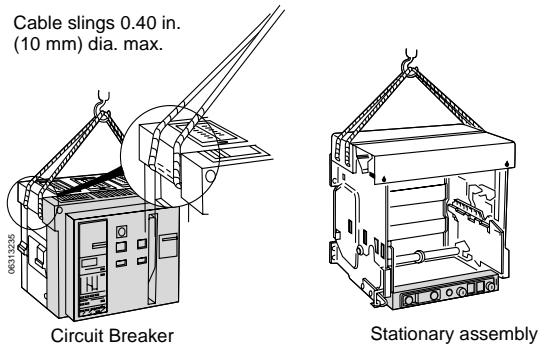
Circuit Breaker Type	Stationary Assembly lbs. (kg)	Circuit Breaker lbs. (kg)	Terminals lbs. (kg)
MP08	51 (23)	102 (46)	13 (6)*
MP12	51 (23)	102 (46)	13 (6)*
MP16	51 (23)	102 (46)	13 (6)
MP20	60 (27)	121 (55)	36 (16)
MP25	110 (50)	176 (80)	89 (40)
MP30	110 (50)	176 (80)	89 (40)
MC08	51 (23)	102 (46)	13 (6)*
MC16	51 (23)	102 (46)	13 (6)
MC20	60 (27)	121 (55)	36 (16)

\*Optional terminals.

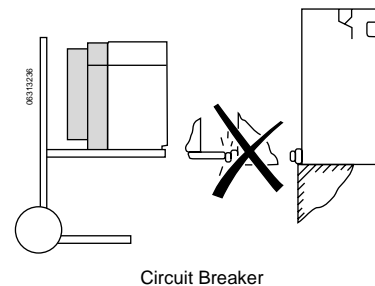
**Figure 7: Using the Lifting Flanges**



**Figure 8: Using a Lifting Sling**



**Figure 9: Using an Electrical or Mechanical Platform Lift**



**CAUTION**

**HAZARD OF EQUIPMENT DAMAGE**

Do not let the forks of a fork lift protrude past the rear of the circuit breaker.

**Failure to follow this instruction can result in equipment damage.**

MC32 Circuit Breakers

**⚠ DANGER**

**HAZARD OF CIRCUIT BREAKER FALLING**

- Be sure equipment has adequate lifting capacity for the unit being lifted.
- Follow manufacturer's instructions for use of lifting equipment.
- Wear hard hat, safety shoes and heavy gloves.

**Failure to follow this instruction will result in death or serious injury.**

The circuit breaker and its stationary assembly have lifting flanges for lifting. Before handling the circuit breaker, remove it from the stationary assembly. To lift the circuit breaker as shown, use an overhead lifting device attached to the notched lifting flanges.

Figure 10: Using a Lifting Sling for Circuit Breaker

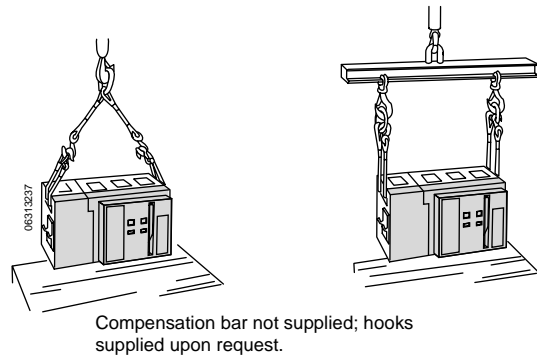
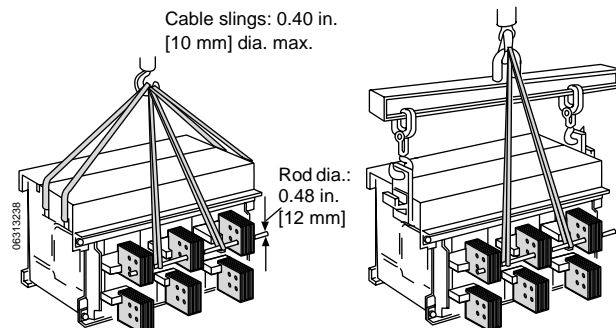


Table 2: 3-pole Circuit Breaker Weights

Type	Stationary Assembly	Circuit Breaker	Terminals
	lbs. (kg)	lbs. (kg)	lbs. (kg)
MC32	132 (60)	198 (90)	88 (40)

Figure 11: Using a Lifting Sling for Stationary Assembly



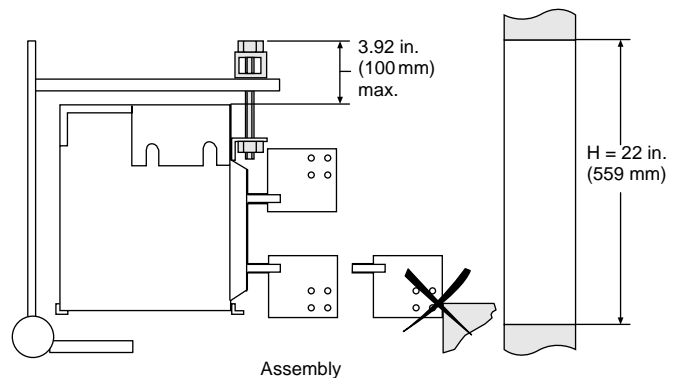
**CAUTION**

**HAZARD OF EQUIPMENT DAMAGE**

Clearance inside the switchboard is minimal. To avoid damage to the load terminals, be sure they clear the lower edge of the switchboard enclosure before attempting installation.

**Failure to follow this instruction can result in equipment damage.**

Figure 12: Using an Electrical or Mechanical Platform Lift



**MP40 to MP63 and MC40 to MC50  
Circuit Breakers**

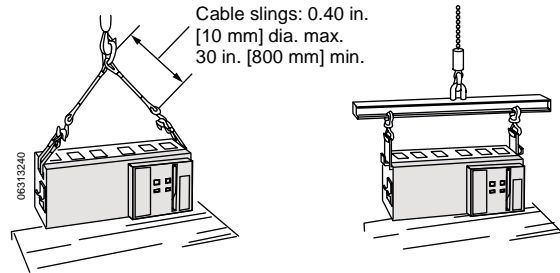
**⚠ DANGER**  
**HAZARD OF CIRCUIT BREAKER FALLING**

- Be sure equipment has adequate lifting capacity for the unit being lifted.
- Follow manufacturer's instructions for use of lifting equipment.
- Wear hard hat, safety shoes and heavy gloves.

**Failure to follow this instruction will result in death or serious injury.**

To lift the circuit breaker as shown below, use an overhead lifting device attached to the notched lifting flanges. Compensation bars not supplied, hooks can be supplied upon request.

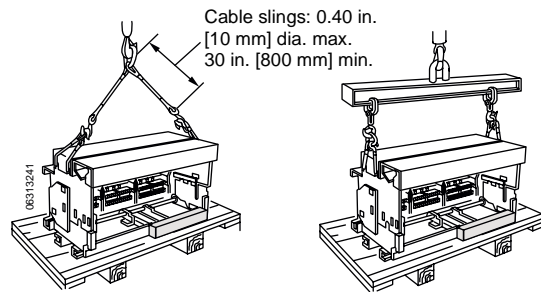
**Figure 13: Using a Lifting Sling for Circuit Breaker**



**Table 3: 3-pole Circuit Breaker Weights**

Type	Stationary Assembly lbs (kg)	Circuit Breaker lbs (kg)	Terminals lbs (kg)
MP40	198 (90)	264 (120)	88 (40)
MP50	198 (90)	264 (120)	177 (80)
MP63	242 (110)	308 (140)	177 (80)
MC40	198 (90)	264 (120)	88 (40)
MC50	198 (90)	264 (120)	177 (80)

**Figure 14: Using a Lifting Sling for Stationary Assembly**

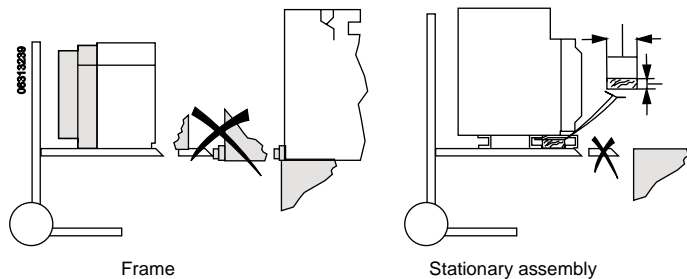


**CAUTION**  
**HAZARD OF EQUIPMENT DAMAGE**

- Do not let the forks of a fork lift protude past the rear of the circuit breaker.
- Place a chock as shown. Remove it as soon as the forks lean on the switchboard floor.

**Failure to follow this instruction can result in equipment damage.**

**Figure 15: Using an Electrical or Mechanical Platform Lift**



MF12, MF20 and MF30 Circuit Breakers

**⚠ DANGER**

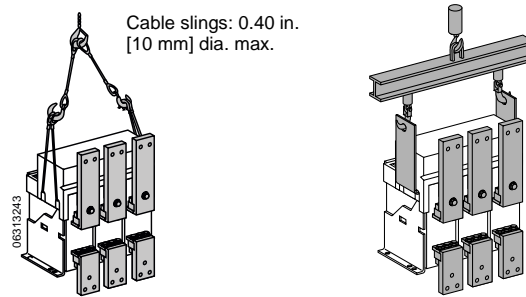
**HAZARD OF CIRCUIT BREAKER FALLING**

- Be sure equipment has adequate lifting capacity for the unit being lifted.
- Follow manufacturer's instructions for use of lifting equipment.
- Wear hard hat, safety shoes and heavy gloves.

**Failure to follow this instruction will result in death or serious injury.**

To lift the circuit breaker as shown, use an overhead lifting device attached to the notched lifting flanges. Compensation bar not supplied, hooks supplied upon request.

**Figure 16: Using a Lifting Sling (MF12 and MF20 Circuit Breakers)**



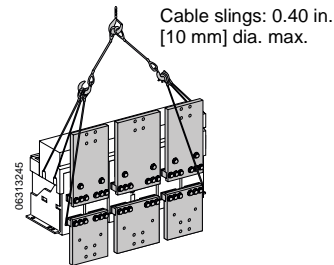
**CAUTION**

**HAZARD OF EQUIPMENT DAMAGE**

Clearance inside the switchboard is minimal. To avoid damage to the load terminals, be sure they clear the lower edge of the switchboard enclosure before attempting installation.

**Failure to follow this instruction can result in equipment damage.**

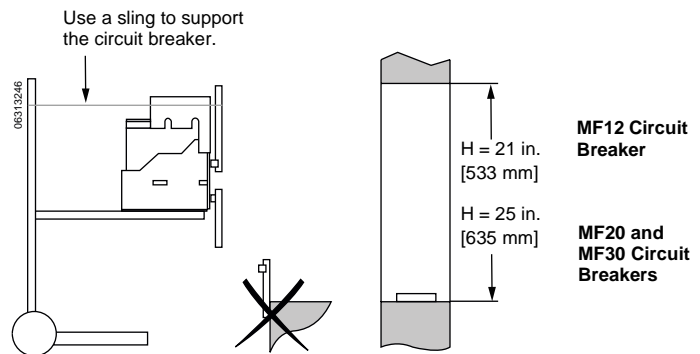
**Figure 17: Using a Lifting Sling (MF30 Circuit Breaker)**



**Table 4: 3-pole Circuit Breaker Weights**

Type	Circuit Breaker	Terminals
lbs. (kg)	lbs. (kg)	lbs. (kg)
MF12	121 (55)	58 (26)
MF20	176 (80)	76 (34)
MF30	264 (120)	187 (85)

**Figure 18: Using an Electrical or Mechanical Platform Lift (Fixed-mounted MF12, MF20 and MF30 Circuit Breaker)**



**Table 8: Bus Bar Connection**

	Expected Short-circuit Current (kA rms)					
	30	50	65	80	100	150
<b>MP08 to MP16 and MC08 to MC16 Circuit Breakers</b>						
Dimension C in. (mm)	13.75 (350)	11.88 (300)	9.88 (250)	7.89 (200)	6.00 (150)	6.00 (150)
<b>MP20 to MP63 and MC20 to MC50 Circuit Breakers</b>						
Dimension C in. (mm)	13.75 (350)	11.89 (300)	9.88 (250)	7.88 (200)	7.88 (200)	7.88 (200)

## CONTROL WIRING

### **⚠ DANGER**

#### **HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION**

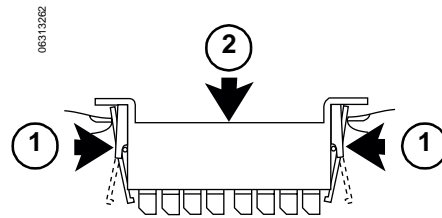
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

**Failure to follow this instruction will result in death or serious injury.**

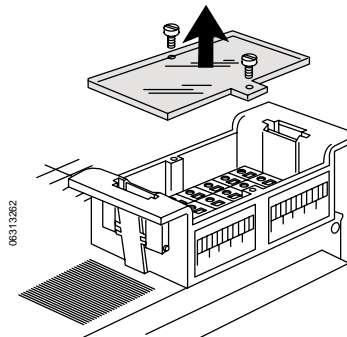
Connect each terminal using one stranded #18 to #14 AWG (0.6 to 2.5 mm<sup>2</sup>) copper wire. Cable strip length: 3/8 in. (9mm).

### Fixed-mounted Circuit Breakers

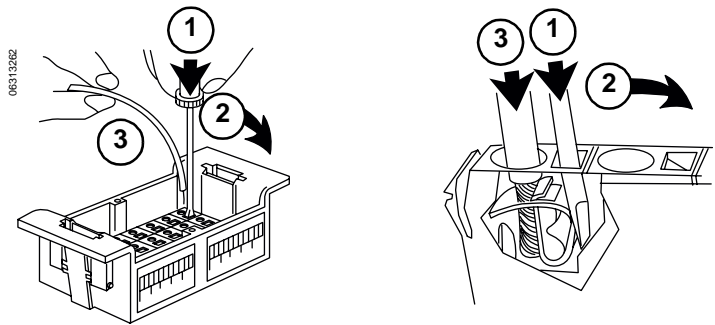
1. Install conductor.



2. Remove transparent shield.

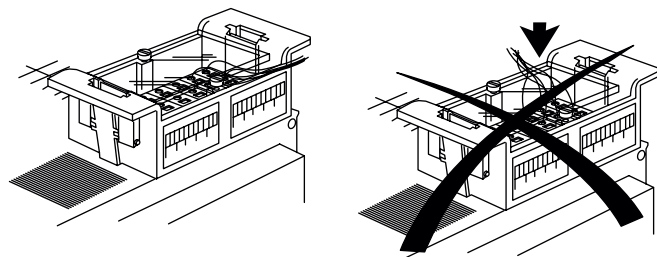


3. Connect control wires according to wiring diagrams shown on the label. Use a small screwdriver to open the spring clips and install wires. Wiring diagrams are also located at the end of this bulletin.



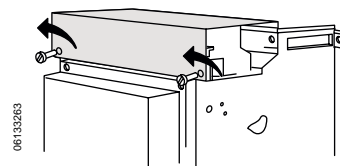
<b>CAUTION</b>
<b>HAZARD OF EQUIPMENT DAMAGE</b>
Do not route control wires close to the arc chutes venting holes. If this is done, wire insulation may melt and/or softening occur during circuit breaker interruption.
<b>Failure to follow this instruction can result in equipment damage.</b>

4. Route control wires away from the arc chutes. Replace the transparent cover.

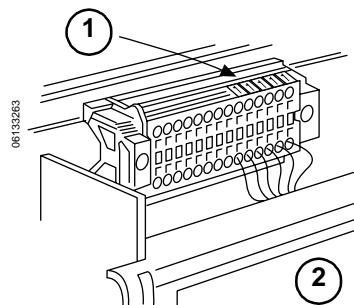


### Drawout-mounted Circuit Breakers

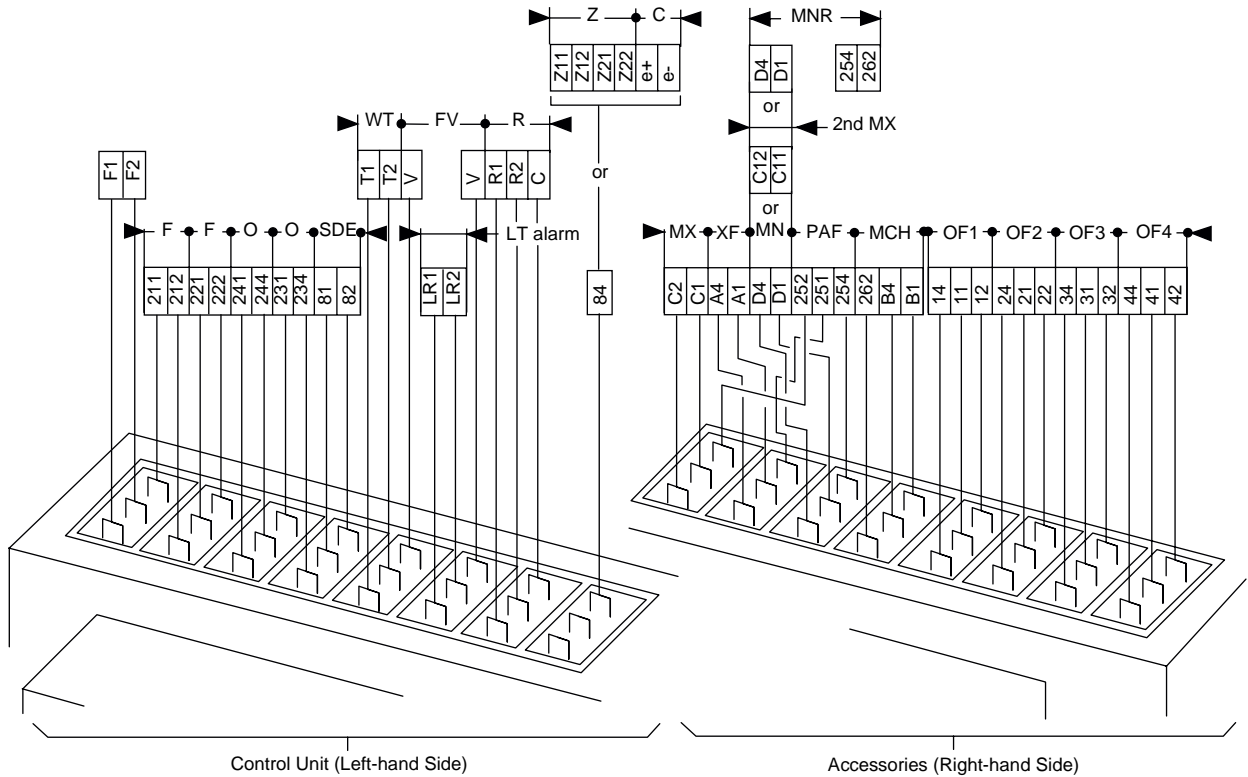
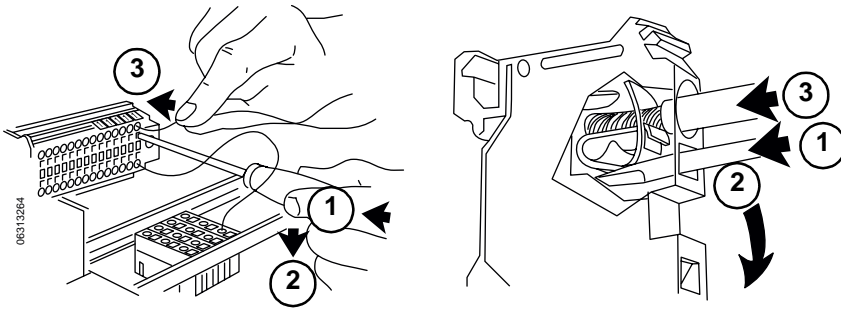
1. Remove the front terminal cover.



2. Determine the terminal number (1) according to the wiring label (2). Wiring diagrams are also located at the end of this bulletin.



3. Connect the control wires using a small screwdriver and replace the front terminal cover.



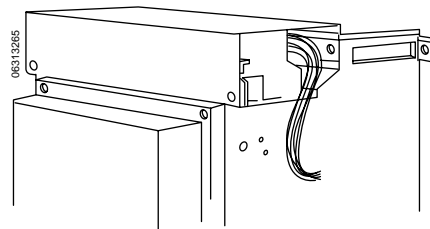
4. Route control wires away from arc chutes.

**CAUTION**

**HAZARD OF EQUIPMENT DAMAGE**

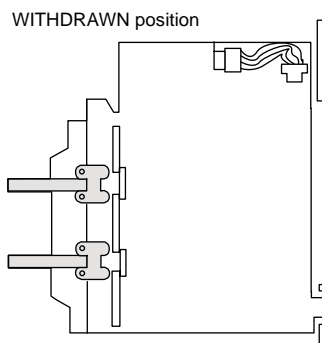
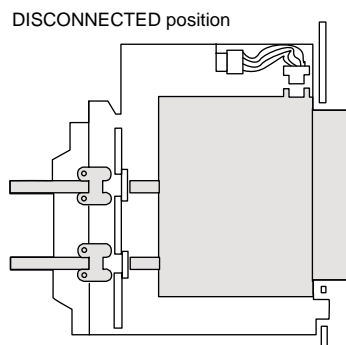
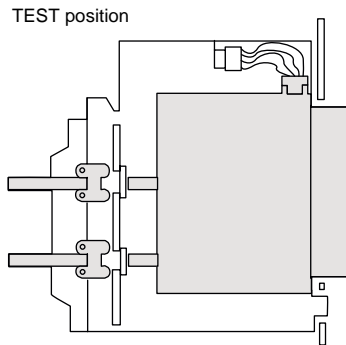
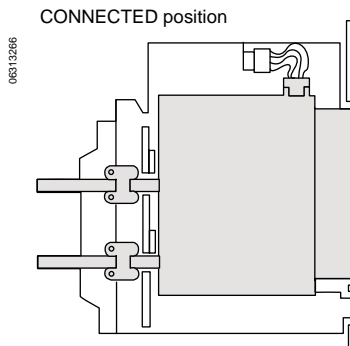
Do not let wires interfere with action of the disconnecting block.

**Failure to follow this instruction can result in equipment damage.**



## SECTION 2— OPERATION

### DISCONNECTING AND CONNECTING INSTRUCTIONS



The circuit breaker has four drawout positions and can be operated in all four positions. The circuit breaker is captive in all positions except WITHDRAWN.



A closed circuit breaker is automatically opened prior to being connected or disconnected during a racking in or racking out operation.

Connection or disconnection of the circuit breaker requires insertion of the racking crank. Insertion of the racking crank can be prevented by the following stationary assembly accessories:

- Padlock
- Key lock
- Racking interlock



Disconnecting and connecting instructions are summarized on the label provided with the installation instructions. The label must be affixed to the door of the switchboard.

- In the CONNECTED position, the primary and secondary disconnecting terminals are engaged, and the circuit breaker is ready for service.
- In the TEST position, the primary terminals are disengaged, however, control contacts are connected to permit operation of the circuit breaker. The TEST position is used for testing circuit breaker operation and control system functions. In this position, the circuit breaker is not suitable for internal inspection or any maintenance function.
- In the DISCONNECTED position, the primary and secondary disconnecting terminals are disengaged and separated by a safe distance from the corresponding stationary terminals.
- In the WITHDRAWN position, both primary and secondary contacts are disconnected. The circuit breaker may be removed for complete accessibility.



When a racking crank remains inserted or a circuit breaker is not completely disconnected, the extraction of the right rail is prevented.

### Disconnecting Instructions

## **⚠ DANGER**

### **HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION**

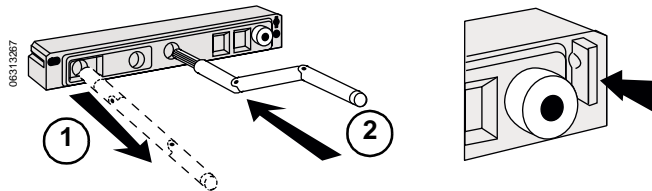
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

**Failure to follow this instruction will result in death or serious injury.**



If the circuit breaker is not opened before disconnecting, it will open automatically during disconnection.

1. Remove the racking crank from its storage hole, insert it into the racking slot, and engage the mechanism.

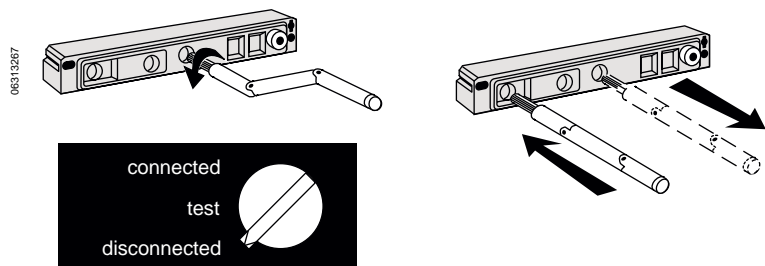


In the case of a racking interlock, press the “compartment door closed” sensor located at the front of the drawout mechanism to simulate a closed door.

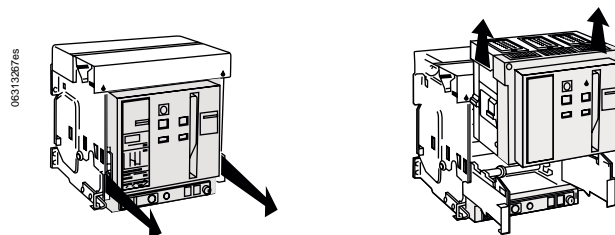
2. To reach the DISCONNECTED position, turn the racking crank counterclockwise until first the TEST, and then DISCONNECTED indication are shown on the position indicator.
3. Remove the racking crank and insert it into the storage hole.



If the racking crank is not removed, the right rail will not fully extend.



4. Using the two extension rail handles, pull the circuit breaker out.
5. Remove the circuit breaker using one of the lifting methods explained in **Handling**, page 9.

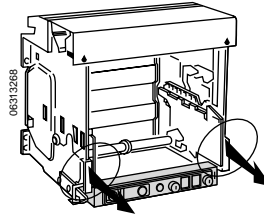


### Installing the Circuit Breaker in the Stationary Assembly

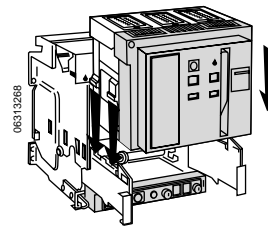
1. Pull out the two extension rails by their handles.



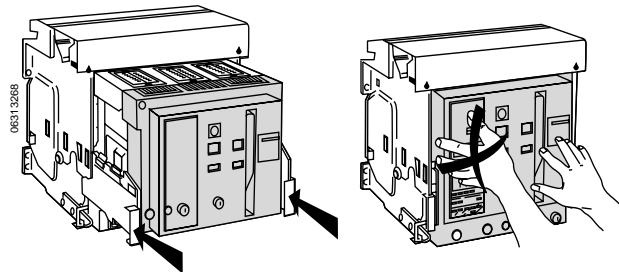
When either the racking crank remains inserted in the racking slot or the circuit breaker is not fully disconnected, extraction of the right extension rail is not possible.



2. Install the circuit breaker onto both extension rails, being sure that the two circuit breaker supports located on either side are fully engaged in the rail slots. Refer to **Handling**, page 9, for methods of lifting the circuit breaker.



3. To move the circuit breaker from the WITHDRAWN position to the DISCONNECTED position, push the extension rail handles into the stationary assembly until they stop.



## CAUTION

### HAZARD OF EQUIPMENT DAMAGE

Do not let the forks of a fork lift protrude past the rear of the circuit breaker.

Do not press on the control unit while pushing the circuit breaker into the stationary assembly.

**Failure to follow this instruction can result in equipment damage.**

### Connecting Instructions

## **⚠ DANGER**

### HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

**Failure to follow this instruction will result in death or serious injury.**

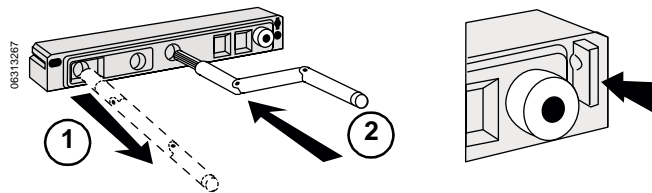
1. Insert and engage racking crank into the racking slot.

*NOTE: This procedure is possible only if:*

- circuit breaker is in **DISCONNECTED** position,
- drawout mechanism padlocks have been removed,
- key interlock has been unlocked and
- compartment door is closed.



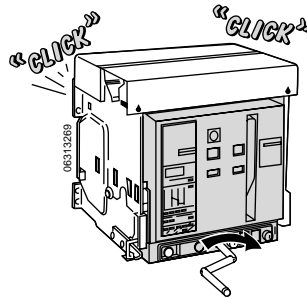
In case of racking interlock, press the “compartment door closed” sensor located at the drawout mechanism to simulate a closed door.



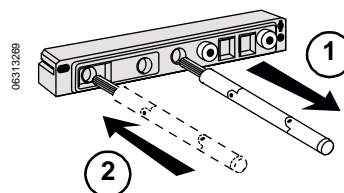
2. Turn the racking crank clockwise until the **CONNECTED** position is reached on the position indicator. Continue cranking until two “click” sounds are heard indicating the circuit breaker is locked in the connected position.



As the **CONNECTED** position is neared, more effort will be required to turn the crank.



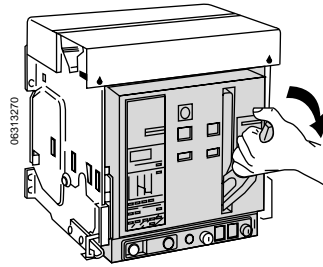
3. Remove the racking crank and insert it back into the storage hole.



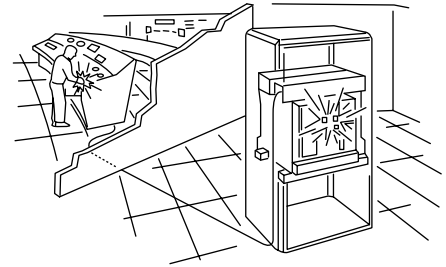
## OPERATING

### Charging Instructions

All basic circuit breaker and drawout operations can be performed from the front of the circuit breaker. Suitable electrical and mechanical interlocks are provided to prevent incorrect operation of the circuit breaker. To manually charge an electrically- or manually-operated circuit breaker, push or pull down on the charging handle, six full strokes should be used. When the spring is fully charged, the yellow “**charged**” indicator will appear in the stored-energy window on the circuit breaker front cover, the handle stops, and it will return to normal position when released.



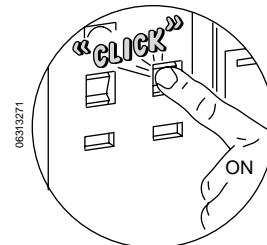
Manual Charging



Electrical Charging

### Closing Instructions

All that is required to close the circuit breaker locally is to push the mechanical **push ON** button. Pre-charged circuit breakers may be closed remotely via a spring-released solenoid which is standard for electrically operated circuit breakers and optional for manually-operated circuit breakers. Before attempting to close the circuit breaker locally, the stored-energy indicator window must show a yellow “**charged**.”



Circuit breaker can be closed only if:

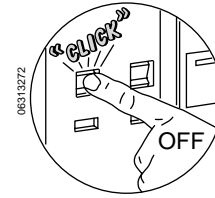
- It is opened
- It is charged
- Pop-out type fault indicator is correctly reset
- No remote opening order is intended.



The closing coil (XF) withstands a continuous voltage, providing anti-pumping function. If the circuit breaker is not ready to close when the closing order is intended, inhibit it and try again as soon as the circuit breaker is ready to close. To inhibit the anti-pumping function, wire in series the ready-to-close switch (terminals 251-252) with the closing coil.

## Opening Instructions

Opening the circuit breaker locally is accomplished by pushing the mechanical **push OFF** button on the circuit breaker front cover. Circuit breakers may be opened remotely via either a shunt trip or an undervoltage trip device depending upon the application requirements.



## Resetting Instructions

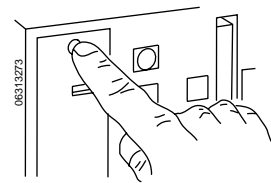
### CAUTION

#### HAZARD OF EQUIPMENT DAMAGE

Resetting the circuit breaker with an existing overcurrent or ground-fault condition can result in destructive arcing. Be sure any existing faults are cleared prior to resetting.

**Failure to follow this instruction can result in equipment damage.**

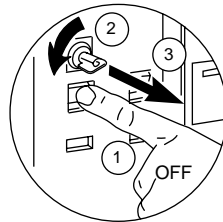
The mechanical fault indicator (**push to reset** button) extends to indicate that an overcurrent has occurred and prevents closure of the circuit breaker. Reset by pushing button in.



## LOCKING

### Locking by Key Interlock

**Figure 22: Locking by Key Interlock (VSKA)**

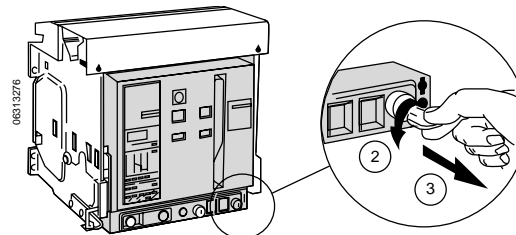


Locking in open position:

1. Push the **push OFF** button
2. Insert and turn the key counterclockwise
3. Remove the key

This locking can be in DISCONNECTED position or in all positions: CONNECTED, TEST and DISCONNECTED (upon request).

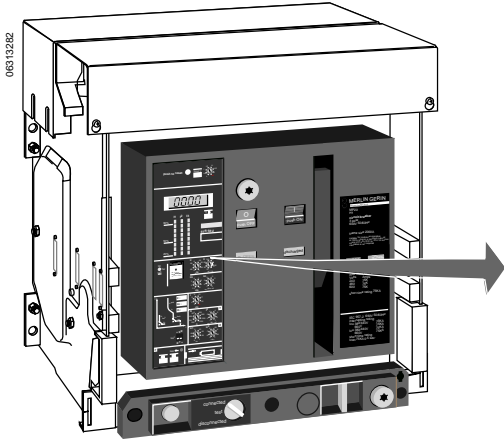
**Figure 23: Locking by Key Interlock (VSKC)**



Locking in the DISCONNECTED position:

1. Disconnect the circuit breaker,
2. insert key and turn counterclockwise and
3. remove the key.

## SECTION 3— CONTROL UNIT TYPES



- $I_o$  = Rating plug
- $I_n$  = Sensor rating
- $I_r$  = Long-time pickup
- $t_r$  = Long-time delay
- $I_m$  = Short-time pickup
- $t_m$  = Short-time delay
- $I$  = Instantaneous pickup
- $I_h$  = Ground-fault pickup
- $t_h$  = Ground-fault delay



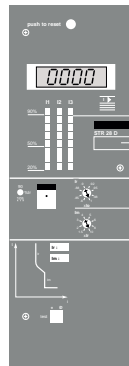
### STR 18 M Control Unit

#### Overcurrent protection

- Instantaneous

#### Options

- None



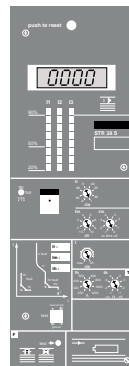
### STR 28 D Control Unit

#### Overcurrent protection

- Long-time
- Instantaneous

#### Options

- Ammeter



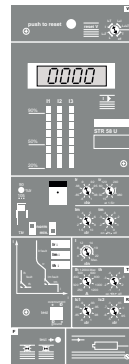
### STR 38 S Control Unit

#### Overcurrent protection

- Long-time
- Short-time
- Instantaneous

#### Options

- Ammeter
- Fault Indicators
- Ground-fault Protection



### STR 58 U Control Unit

#### Overcurrent protection

- Long-time
- Short-time
- Instantaneous

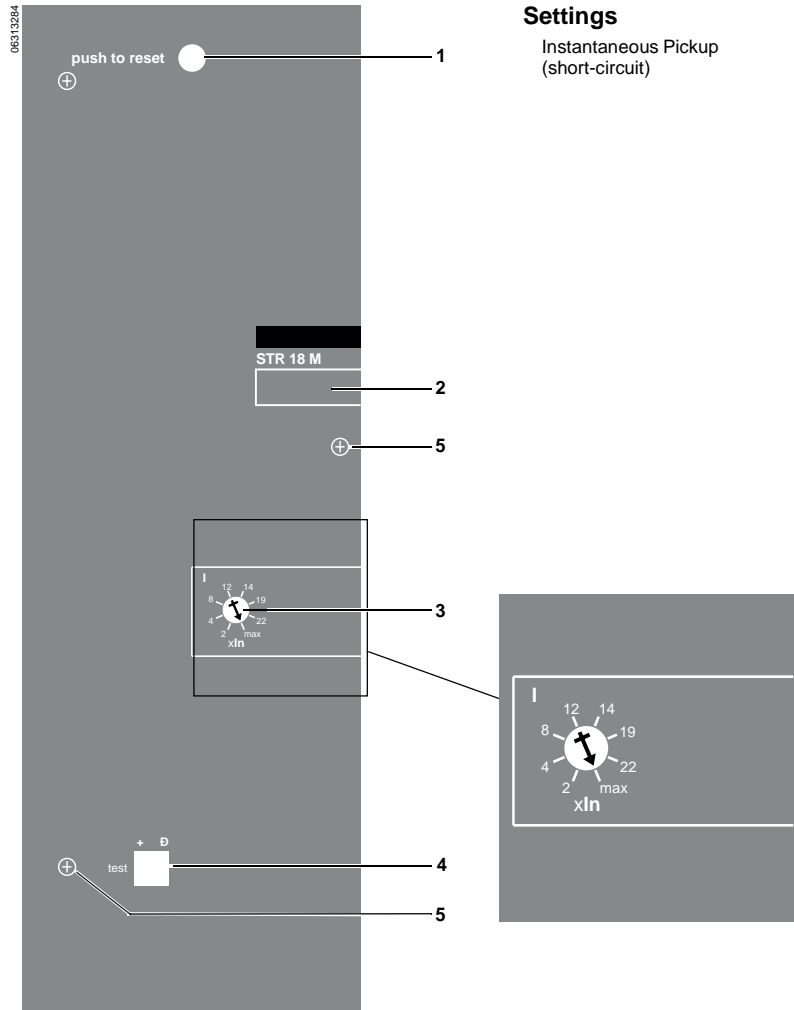
#### Options

- Ammeter
- Fault Indicators
- Ground-fault Protection
- Zone-selective interlocking
- Load Monitoring
- Communication

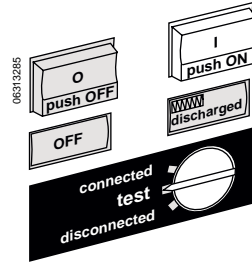
## STR 18 M CONTROL UNIT

### Description

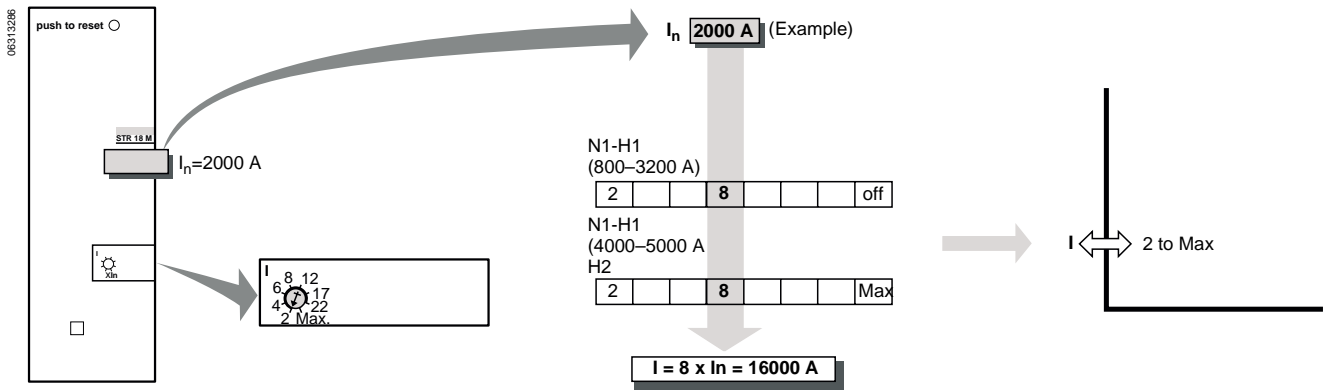
1. Fault trip indicator reset button prevents reclosing of circuit breaker after fault until reset.
2. Current sensor rating ( $I_n$ )
3. Instantaneous setting (can be turned OFF on N1 and H1 circuit breakers)
4. Test the receptacle **BU** **ME**
5. Lock the control unit settings (captive nuts) **PBD**



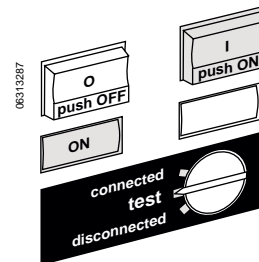
1. Before energizing main circuits, open and discharge circuit breaker.



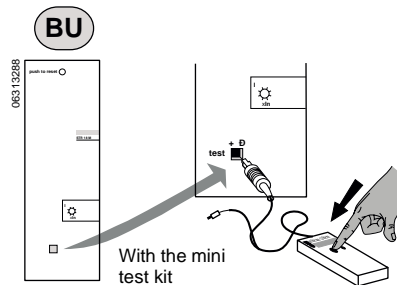
2. Adjust control unit.



3. Close circuit breaker.



4. Test the control unit.



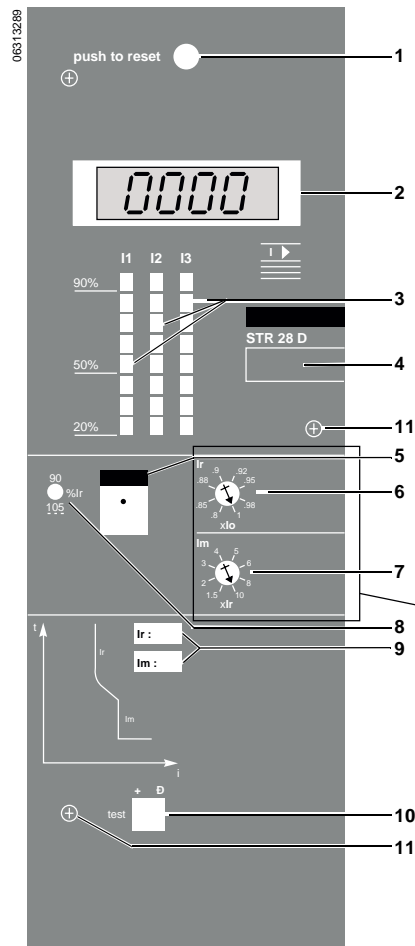
ME

The complete test kit can simulate a short circuit.

## STR 28 D CONTROL UNIT

### Description

1. Fault trip indicator reset button prevents reclosing circuit breaker after fault until reset
2. Measure the current I
3. Indicates the rate of load (% $t_r$ ) I
4. Current sensor rating ( $I_n$ ) I
5. Rating plug ( $I_o$ ) ALR
6. Adjust  $I_f$  (long-time setting) BU ME
7. Adjust  $I_m$  (instantaneous) PBD
8. Overload indicator
9. Control unit setting values
10. Test the control unit
11. Lock the control unit settings



### Settings

Adjustable

$I_f$  Long-time setting (overload)

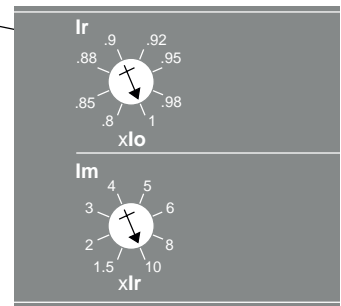
$I_m$  Instantaneous setting (short-circuit)

Fixed

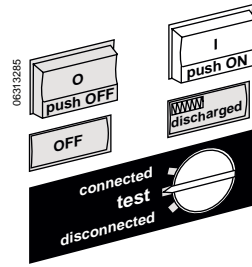
$t_r$  Long-time delay

### Options

Option I see page 38

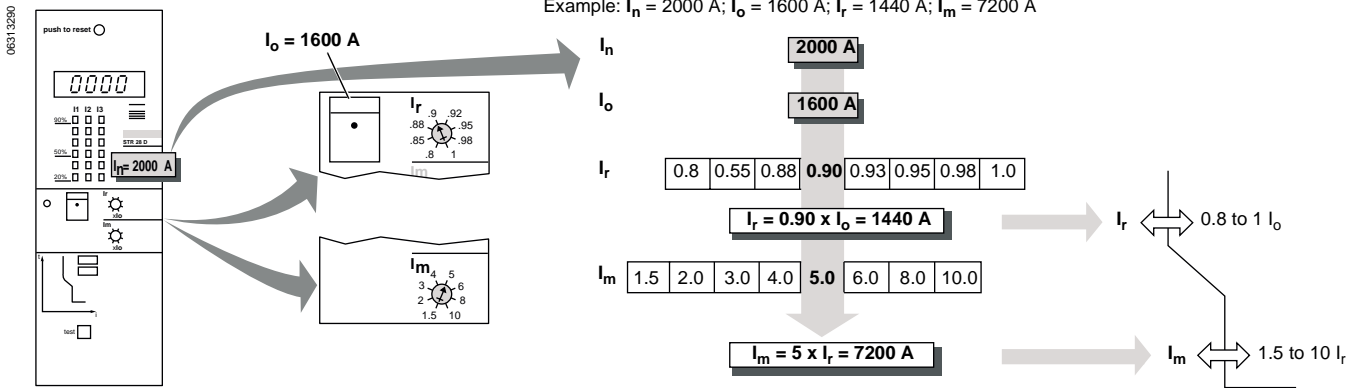


1. Before energizing main circuits, open and discharge circuit breaker.

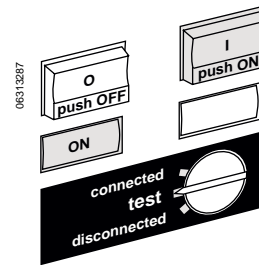


2. Adjust control unit.

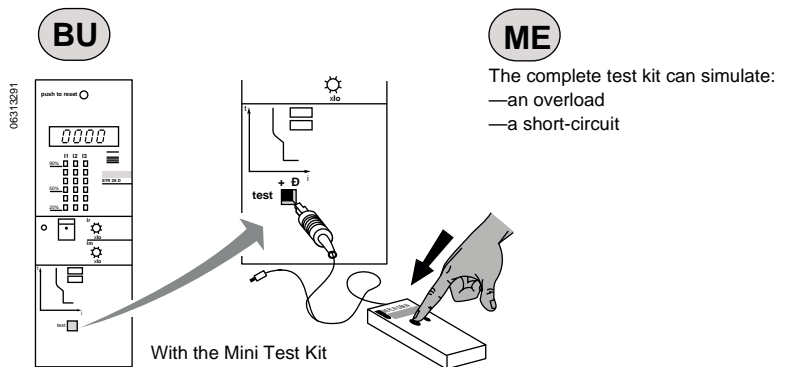
Example:  $I_n = 2000\text{ A}$ ;  $I_o = 1600\text{ A}$ ;  $I_r = 1440\text{ A}$ ;  $I_m = 7200\text{ A}$



3. Close circuit breaker.



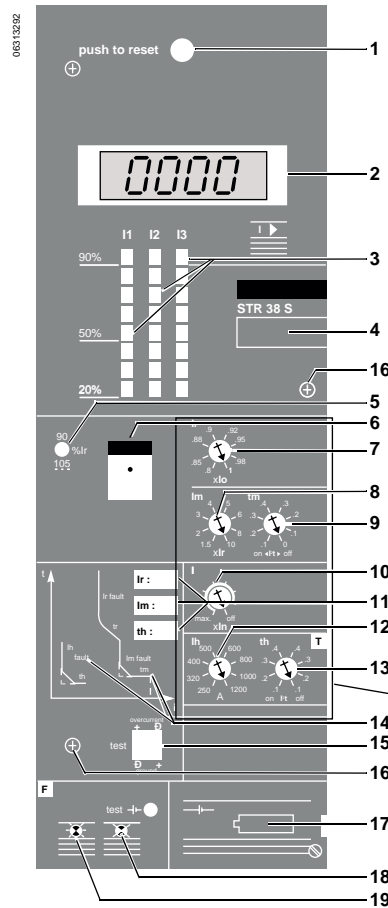
4. Test the control unit.



## STR 38 S CONTROL UNIT

### Description

1. Fault trip indicator reset button prevents reclosing circuit breaker after fault until reset.
2. Measure the current. **I**
3. Indicates the rate of load (% $t_r$ ) **I**
4. Current sensor rating ( $I_n$ ) **ALR**
5. Overload indicator **ALR**
6. Rating plug ( $I_o$ ) **ALR**
7. Adjust  $I_r$  (long-time setting)
8. Adjust  $I_m$  (short-time setting)
9. Adjust  $t_m$  (short-time delay)
10. Control unit setting values
11. Switch on or off the instantaneous protection (N1/H1 type only)
12. Adjust  $I_h$  (ground-fault protection) **T** **W**
13. Adjust  $t_h$  (ground-fault protection delay) **T** **W**
14. Fault trip indicator **F**
15. Test the control unit **BU** **ME**
16. Lock the control unit settings **PBD**
17. Save fault trip indicator **PIL**
18. Clear fault trip indicator and / or check battery level **F** + **PIL**
19. Recall the latest fault trip indicator **F** + **PIL**



### Settings

#### Adjustable

$I_r$  Long-time setting (overload)

$I_m$  Short-time setting (short-circuit)

$t_m$  Short-time delay  
 $I^2t$  on or off

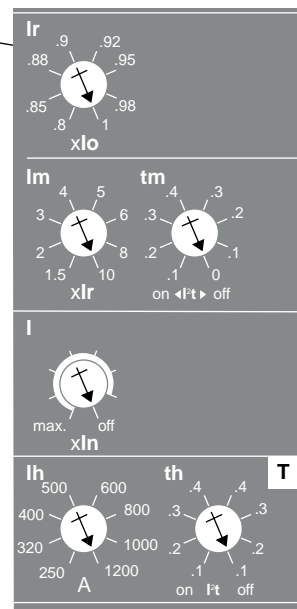
### Options

Option **I** see page 38

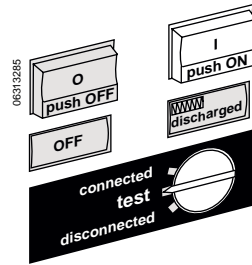
Option **F** see page 39

Option **T** see page 41

Option **W** see page 41

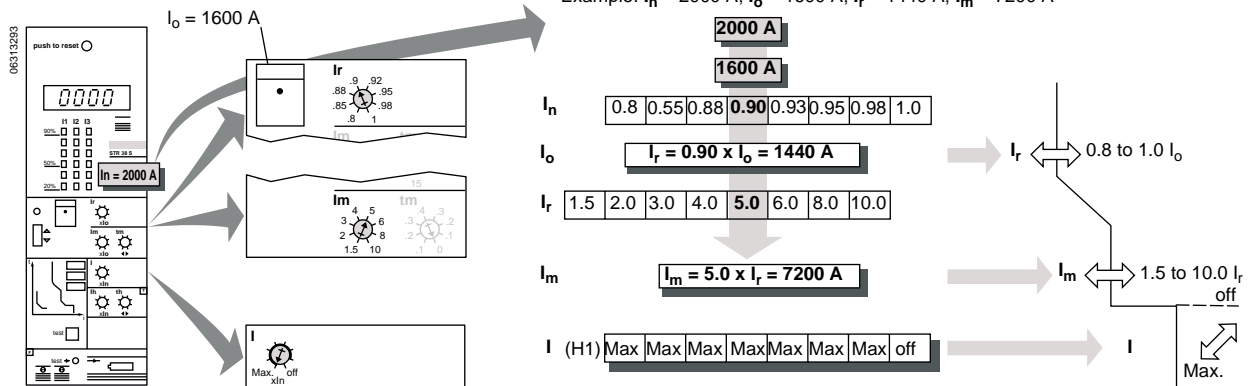


1. Before energizing main circuits, open and discharge circuit breaker.



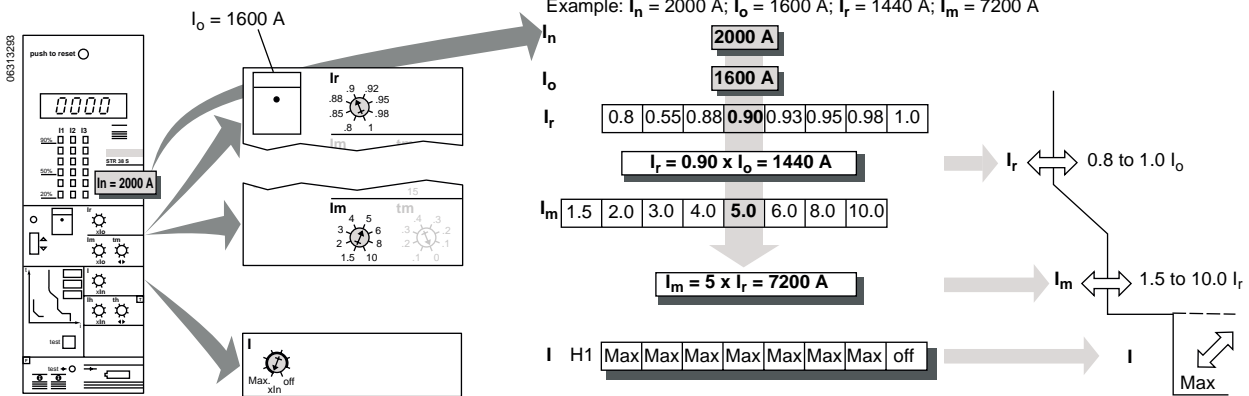
2. Adjust control unit.

Example:  $I_n = 2000 \text{ A}$ ;  $I_o = 1600 \text{ A}$ ;  $I_r = 1440 \text{ A}$ ;  $I_m = 7200 \text{ A}$

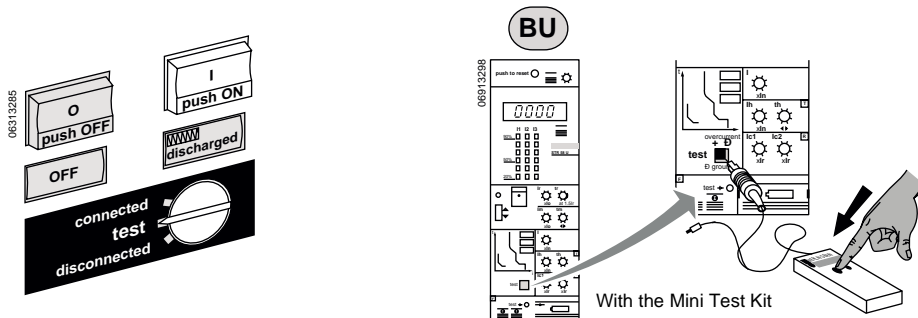


3. Close circuit breaker.

Example:  $I_n = 2000 \text{ A}$ ;  $I_o = 1600 \text{ A}$ ;  $I_r = 1440 \text{ A}$ ;  $I_m = 7200 \text{ A}$



4. Test the control circuit.

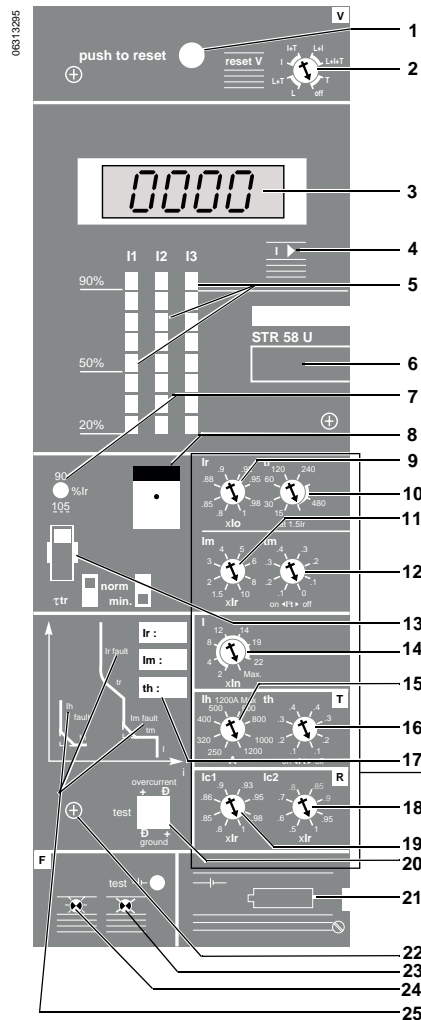


**ME**  
The complete test kit can simulate:  
—an overload  
—a short-circuit  
—a ground-fault

## STR 58 U CONTROL UNIT

### Description

1. Fault trip indicator reset button prevents reclosing of circuit breaker after fault until reset
2. Select the remote indicated fault trip **FV**
3. Measure the current **I**
4. Select phase to measure **I**
5. Indicates the rate of load (% $t_r$ ) **I**
6. Maximum protection rating **ALR**
7. Overload indicator
8. Rating plug ( $I_o$ )
9. Adjust  $I_r$  (long-time setting)
10. Adjust  $t_r$  (long-time delay)
11. Adjust  $I_m$  (short-time setting)
12. Adjust  $t_m$  (short-time delay)
13. Decrease thermal memory after tripping
14. Adjust  $I$  (instantaneous) **T** **W**
15. Adjust  $I_h$  (ground-fault protection) **T** **W**
16. Adjust  $t_h$  (ground-fault protection delay) **T** **W**
17. Control unit setting values **R**
18. Adjust  $I_{c2}$  (load monitoring) **R**
19. Adjust  $I_{c1}$  (load monitoring) **R**
20. Test the control unit **BU** **ME**
21. Save fault trip indicator **PIL**
22. Lock the control unit settings **PBD**
23. Clear fault trip indicator and/or check battery level **F** + **PIL**
24. Recall the latest fault trip indicator **F** + **PIL**
25. Fault trip indicator



### Settings

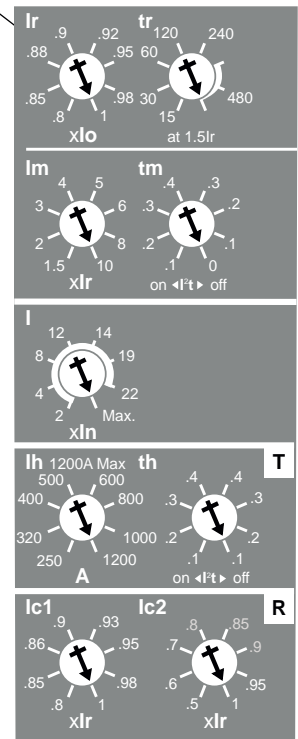
#### Adjustable

- $I_r$  Long-time setting (overload)
- $t_r$  Long-time delay
- $I_m$  Short-time setting (short-circuit)
- $t_m$  Short-time delay
- $I^2t$  on or off

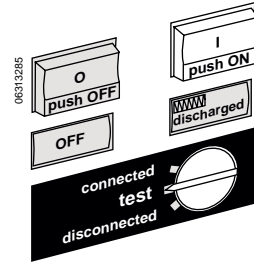
#### Options

Thermal memory limitation see page 37 function

- Option **I** see page 38
- Option **F** see page 39
- Option **FV** see page 41
- Option **R** see page 40
- Option **T** see page 41
- Option **W** see page 41
- Option **Z** see page 42
- Option **C** see page 42

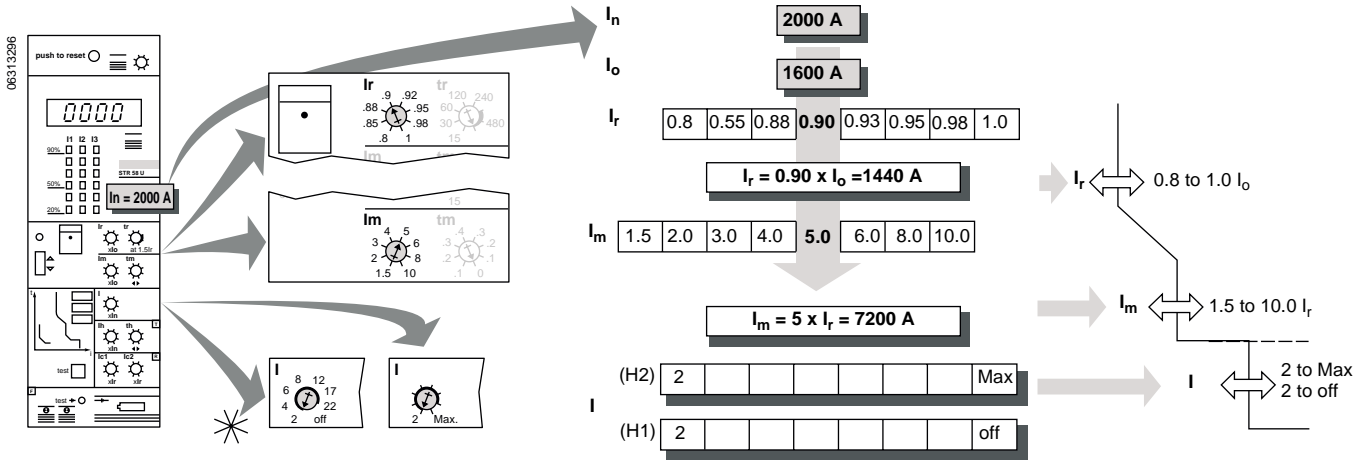


1. Before energizing main circuits, open and discharge circuit breaker.

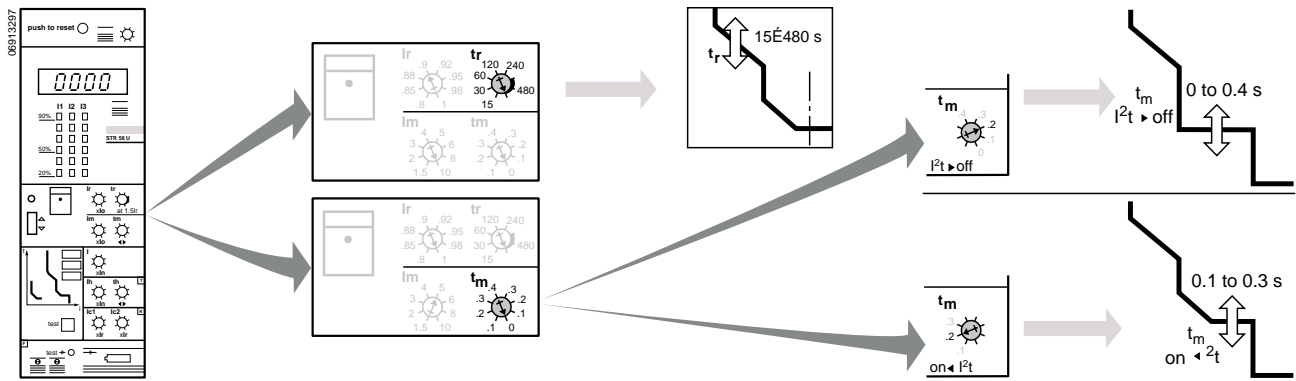


2. Adjust control unit.

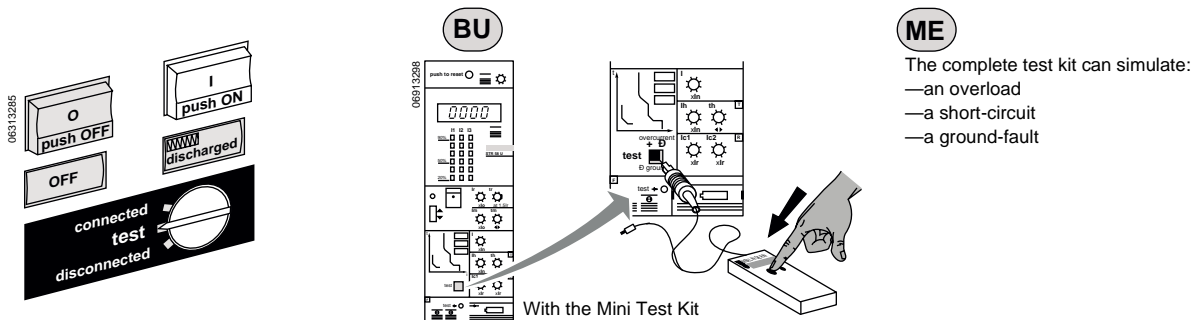
Example:  $I_n = 2000 \text{ A}$ ;  $I_o = 1600 \text{ A}$ ;  $I_r = 1440 \text{ A}$ ;  $I_m = 7200 \text{ A}$



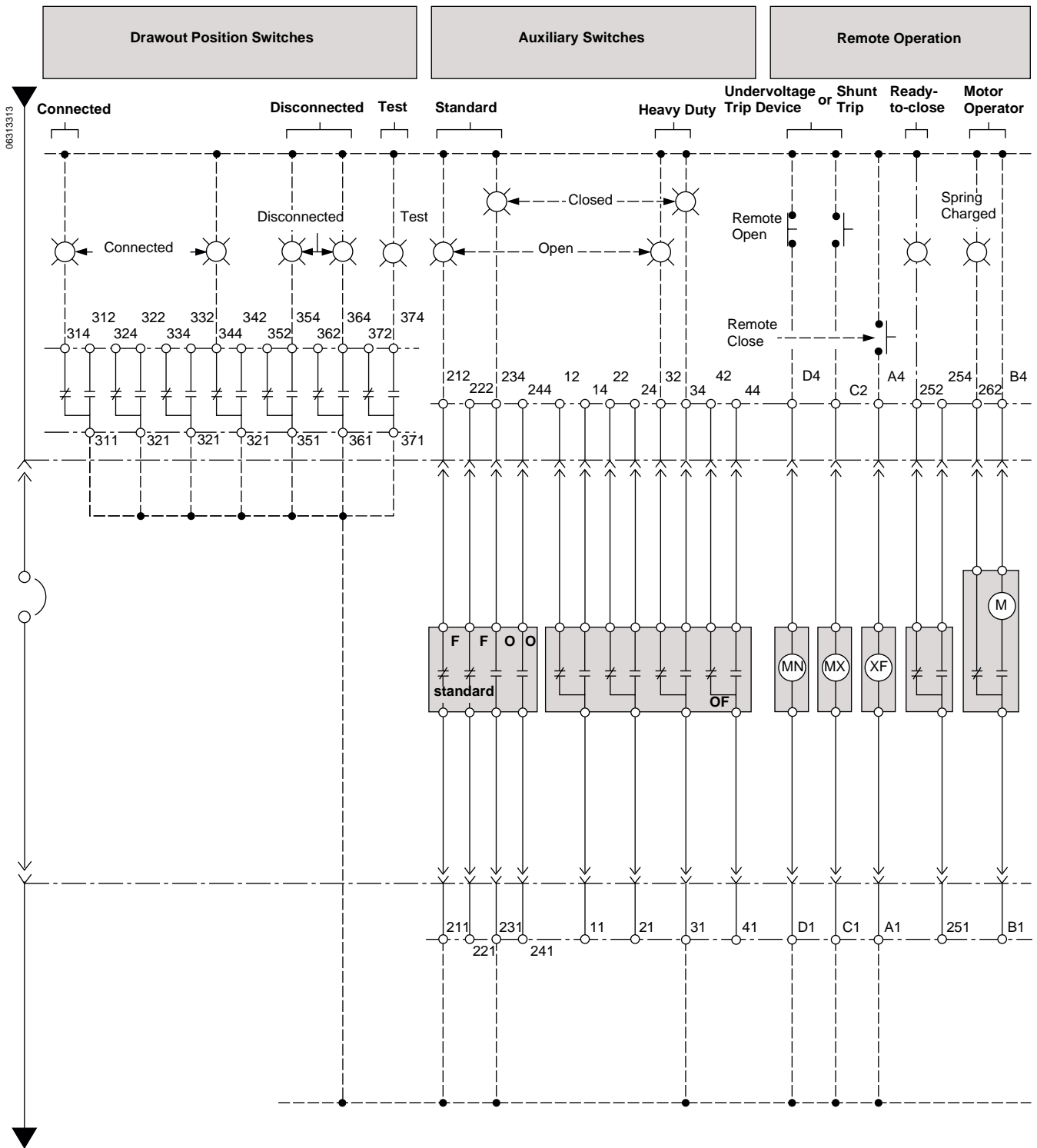
3. Close circuit breaker.



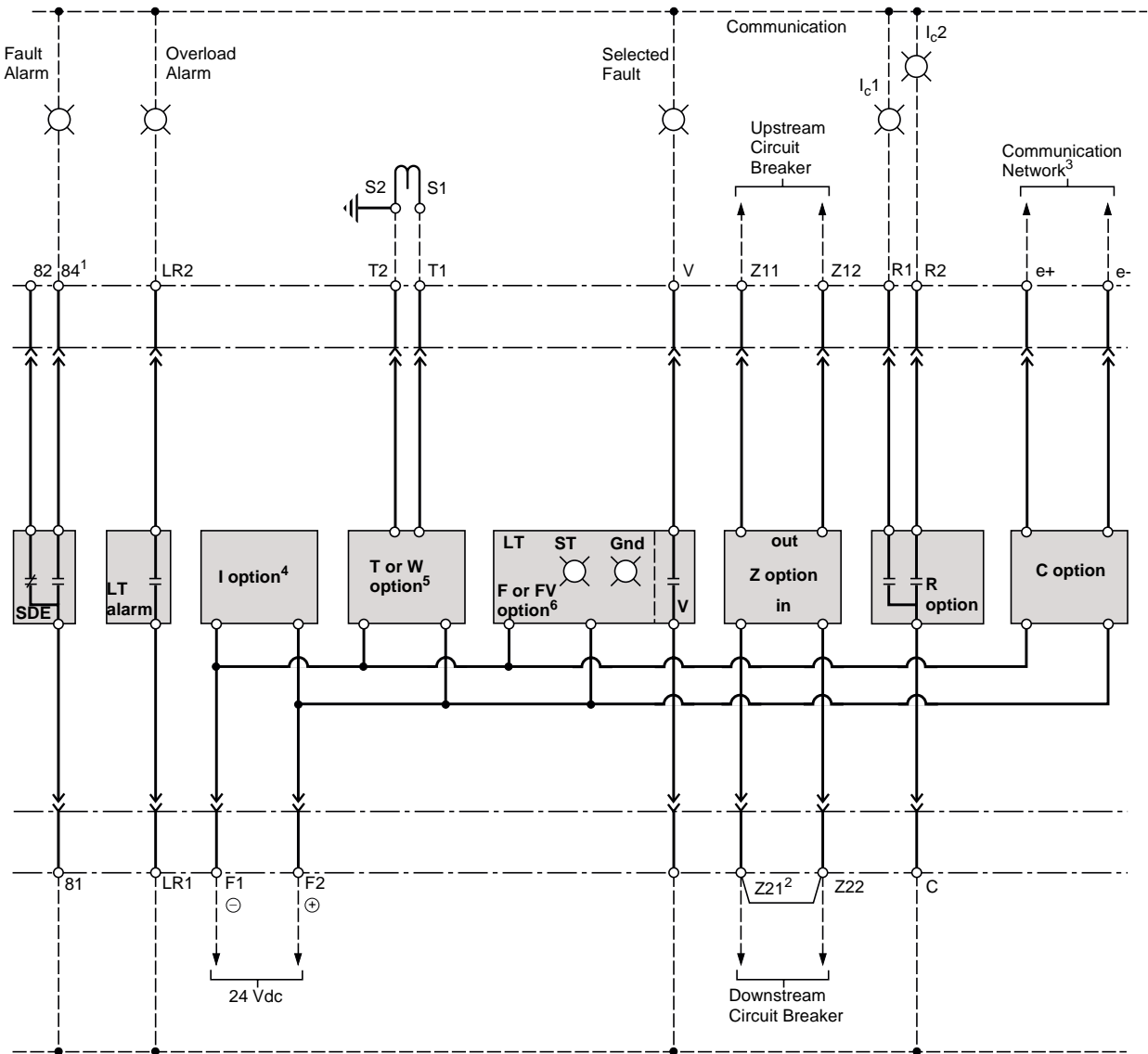
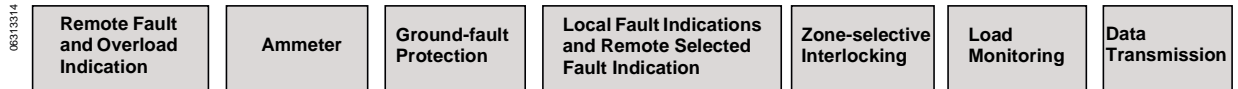
4. Test the control unit.



WIRING DIAGRAM



Circuit breaker shown in connected, charged and open position, undervoltage release energized.



- <sup>1</sup> 84 terminal not available with Z or C option.
- <sup>2</sup> Zone-selective interlocking with downstream circuit breaker requires removal of jumper from drawout circuit breaker.
- <sup>3</sup> Communication output through DIGIPACT® module.
- <sup>4</sup> Use 24 Vdc supply if I max, information is to be retained after the circuit breaker has tripped.
- <sup>5</sup> Use 24 Vdc supply for lower setting of ground-fault pickup (red zone), or when load is less than 20% of sensor rating.
- <sup>6</sup> Use 24 Vdc supply for F option if not supplied with PIL (battery) option.  
Use 24 Vdc supply (mandatory) for FV option.

## 6. VOLTAGE RELAYS

### 6.1 VOLTAGE SENSING – CLOSE DIFFERENTIAL

This relay continuously monitors the voltage of a three phase or a single-phase power source. When the voltage in each phase attains a value equal to or greater than the "pick-up" setting, the output contacts change state and the L.E.D. energizes. When the voltage of any phase falls below the "drop-out" setting, the output contacts revert to their de-energized state and the "LED" turns off.

Pick-up and dropout values are adjustable from 70 to 100% of nominal voltage via two potentiometers that are externally accessible.

#### Factory Setting

Unless a customer or specifications require specific settings, the voltage Sensing Relay will be factory set to dropout at 80% and pick-up at 90% of nominal voltage.

#### Three Phase Style

The Lake Shore voltage-sensing relay is field adjustable. Voltage is selectable by changing the position of a small printed circuit board inside the chassis of the unit.

#### CALIBRATION:

- Select proper voltage range.
- Set pickup potentiometer full clockwise.
- Set dropout potentiometer full counter-clockwise
- Using a small screwdriver, turn the calibrate potentiometer fully clockwise.
- Apply nominal input voltage to unit.
- Slowly turn the calibration potentiometer counter-clockwise until the units picks up as indicated by the "energized" light.
- Set pickup and dropout potentiometers to desired settings.
- Unit is ready for operation.

**Note:** Field adjustment can only be considered approximate if potentiometers are set using the scale on the front of the unit. For an accurate setting of the pickup and dropout points, a variable voltage power supply must be used.

#### Single Phase Style

The single-phase voltage sensing relays are adjustable to 70 to 100% of the voltage range selected. Indication of pickup or dropout can only be verified by attaching a continuity meter to the common and normally open terminals. When the meter shows continuity, the PFR is picked up.

#### CALIBRATION:

- Remove protective black plugs (if present).
- Using a small slotted screwdriver, turn the dropout potentiometer fully counter-

clockwise.

Using a small slotted screwdriver, turn the pickup potentiometer fully clockwise. Apply required level of pickup voltage to the unit.

Turn the pickup potentiometer slowly counter-clockwise until the meter shows continuity.

Reduce the voltage to the required voltage dropout level.

Turn the dropout potentiometer slowly clockwise until the meter shows no continuity.

## 6.2 FREQUENCY VOLTAGE RELAY

### General

This device is used to prevent transfer to the Emergency power source until the emergency power generator has reached correct operating voltage and frequency.

### Factory Setting

The unit pickup set point is factory set at 48 Hz (50 Hz line) or 58 Hz (60 Hz line) and 108 vac. This device is not field-adjustable.

## 7. TROUBLESHOOTING GUIDE

This guide is intended to assist an individual with a basic understanding of electrical circuitry to troubleshoot an automatic transfer switch as manufactured by Lake Shore Electric Corporation.

Any questions relating to the use of this Manual should be referred to the Service Department of Lake Shore Electric Corporation, 205 Willis Street, Bedford, Ohio 44146, Phone (440) 232-0200, Fax (440) 232-5644.

**Note:** Please note that for Utility-to-Utility transfer switches, the following section 7.1 is not applicable. Additionally, all references to TDES, TDEC, MRT and the engine start relay are not applicable.

**CAUTION: WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER FROM ELECTRICAL HAZARD EXISTS. DO NOT ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT TAKING EVERY PRECAUTION TO PREVENT AN ACCIDENT. WARNING!**

IN INSTALLATION AND USE OF THIS PRODUCT, COMPLY WITH THE NATIONAL ELECTRICAL CODE, FEDERAL, STATE AND LOCAL CODES, AND ALL APPLICABLE SAFETY CODES. IN ADDITION, **TURN OFF** POWER AND TAKE OTHER NECESSARY PRECAUTIONS TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE.

WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER OF ELECTROCUTION EXISTS, WHICH MAY RESULT IN INJURY OR DEATH. **DO NOT** ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT FIRST TAKING EVERY PRECAUTION TO PREVENT ACCIDENTAL INJURIES.

The following conditions **MUST** be met before attempting to troubleshoot n Insulated Case Transfer Switch:

1. A wiring diagram for the specific switch must be available.
2. Normal and Emergency voltage and frequency must be available and within the correct operating limits.
3. Control circuit voltage (if transformers are used) must be 110 to 125 volts.
4. Connections to the under-voltage relay must be correct and the relay must be adjusted to pick up on the voltage at which the switch is operating. See voltage relay instructions on a Page 17.
5. All timers must be turned down or considerations given to them while the tests are being conducted.
6. If trip units are included in the switch, they must be reset if previously tripped due to an overload.
7. All electrical connections must be tight and in accordance with the wiring diagram.
8. All components must be free of obvious defects with the exception of normal usage.
9. The switch must be connected to a good earth ground.

When you are satisfied that all the above conditions are met, and all accessories are either working correctly or eliminated, the problem will be confined to:

1. The MP 7600 Controller
2. The interface control relays
3. The interconnections and cable connections
2. The insulated case switches

The troubleshooting procedures outlined here are designed to test the control circuit and the operating mechanism of the transfer switch. It is, therefore, necessary that all factors external to the transfer switch be correct, and that all accessory devices which are not imperative to switch operation either operate satisfactorily or bypassed and jumpered out of the circuit.

Many of the accessory devices described below may not exist in the transfer switch being examined. The proper wiring diagrams should be on hand before beginning work on the switch. We recommend that the entire manual be read before attempting to make any adjustment. Above all, **CAUTION** is recommended.

Many of the troubleshooting tests require a simulated failure of the normal source. This can be done with the Load Test Switch.

## **7.1 NORMAL POWER FAILS – ENGINE DOES NOT START**

- 1) Verify:
  - a) Maintenance Disconnect Switch (if applicable) is in the "NORMAL" position.

- b) LCD Display indicates that the ATS is in the "AUTOMATIC" position.
  - c) 12VDC or 24VDC is available on the control circuit input terminals to the ATS.
- 2) Check the fuse in the DC circuit. Verify that DC voltage is available from either side of the fuse to battery negative. If not, replace the fuse.
  - 3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "NOR" is NOT on.
    - a) If the LED is on, either the main controller board or voltage-sensing relay has failed. To determine which unit failed, disconnect the wire on terminal NOR of the main controller board. If the LED remains on, the main controller board has failed. If the LED turns off, the voltage-sensing relay has failed.
    - b) If the LED is NOT on, continue to the next step.
  - 4) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "ES" is on. If the LED is not on, the main control board has failed. If the LED is on, continue to the next step.
  - 5) Verify that the "ES" relay on the Relay Interface Board is being signaled to energize by measuring the proper DC voltage (either 12VDC or 24VDC) across diode D8 on the Relay interface board.
    - a) If there is no voltage on diode D8, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 16. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 16. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but, not across D8, the relay interface board has failed.
    - b) If there is voltage available on D8 continue to the next step.
  - 6) Verify that the "ES" relay is functioning. Remove the wires from C and NO for the ES relay on the Relay Interface Board. Place an Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay. If there is still no continuity, the Relay Interface Board has failed. If there is continuity here, reconnect the wires from C and NO for the ES relay on the Relay Interface Board and continue to the next step.

- 7) Remove the customer's engine starting wires from terminals 033 and 034 and measure continuity across these terminals. If continuity exists across these terminals, the problem is in the wiring to the engine generator set or the starting system of the engine generator set. If continuity does not exist here check the wiring between these terminals and terminal C and NO for the ES relay on the Relay Interface Board.

## **7.2 ENGINE STARTS – AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO EMERGENCY**

- 1) Check for proper voltage on the generator output. This should be measured at the input terminals to the Automatic Transfer Switch EL1, EL2, and EL3. If the output voltage of the generator is incorrect, contact the engine generator set supplier. If the generator has the proper output voltage continue to the next step.
- 2) Check to see that the Frequency Voltage Relay (FVR) or Emergency Relay (ER) is energized. The FVR has a red LED to indicate that it is energized; the Emergency relay has a yellow neon light to do the same. If not energized review connections from generator input to the FVR of ER relay. If energized continue to next step.
- 3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "EMR" is on.
  - a) If the LED is not on, either the FVR or ER has a failed output contact or the main control board has failed. To determine what has failed, place a jumper on the main control board from terminal "input return" to "EMR". If the "EMR" LED turns on, the FVR or ER output contact has failed. If the "EMR" LED remains off, the main control board has failed.
  - b) If the LED is on, continue to the next step.
- 4) Check to see that the switches have been given a signal to open and close. This step varies between Open Transition and Closed Transition.

An Insulated Case Transfer Switch has two stages to transfer to emergency. First Normal must open and secondly, Emergency must close. For Closed Transition, Emergency must close first, and then Normal must open.

### **a.) NORMAL FAILS TO OPEN – OPEN TRANSITION**

- 1.) For an IC Automatic Transfer Switch "ON" (open normal) will begin the transfer to emergency. If the Normal Insulated Case Switch remains closed verify that the "ON" LED on the main control board is on. If the "ON" LED is not on, the main control board has failed. If the "ON" LED is on continue to the next step.
- 2.) Verify that the "ON" relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of

the "ON" relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

- a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the generator input terminals and this Relay Interface board.
  - b.) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "ON" relay is not closed. Check for DC voltage across D1.
    - (1) If there is no voltage on D1, the main controller board, ribbon cable, and/or the relay interface board has failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 20. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 20. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D1, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.
    - (2) Verify that the "ON" relay is functioning. Remove the wires from C and NO for the ON relay on the Relay Interface Board. Place an Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay. If there is still no continuity, the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the ON relay on the Relay Interface Board. This should resolve the problem.
  - c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the normal switch open coil C1 & C2 (or the dc open normal relay, if used) and the wiring between the Relay Interface Board and the transfer motor.
- b.) EMERGENCY FAILS TO CLOSE – (OPEN TRANSITION)
- 1) For a Style III Automatic Transfer Switch "CE" (close emergency) will complete the transfer to emergency. If the Emergency Insulated Case Switch remains open verify that the "CE" LED on the

main control board is on. If the "CE" LED is not on, the main control board has failed. If the "CE" LED is on continue to the next step.

- 2) Verify that the CE relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CE relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:
  - (a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the generator input terminals and this Relay Interface board.
  - (b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "CE" relay is not closed. Check for DC voltage across D4.
    - (1) If there is no voltage on D4, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 17. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 17. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D4, the relay interface board has failed. If there is nominal DC voltage across D4, continue to the next step.
    - (2) Verify that the "CE" relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place an Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity; the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the CE relay on the Relay Interface Board. This should resolve the problem.
  - (c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the emergency switch close coil A1 & A4 and the wiring between the Relay Interface Board and the transfer motor.

c.) EMERGENCY FAILS TO CLOSE – (CLOSED TRANSITION)

- 1.) For an IC Automatic Transfer Switch with Closed transition option and both sources available, the "AS" (activate synchronization) LED on the main control board must be on. If the "AS" LED is not on, the main control board has failed. If the "AS" LED is on, continue to the next step.
- 2.) Once the normal and emergency source are in sync, the synchronizing device closes it's contact lighting up the "SYNC" LED on the main control board. If this LED is not lit, the two sources are not in sync, the synchronizer is not functioning and/or the main control board has failed. To verify it is not the control board, remove the "CE" (close emergency) relay from the relay interface board to prevent the emergency insulated case switch from closing out of phase and then place a jumper across terminals "input return" and "sync" on the main control board. The "SYNC" LED should light indicating that the main control board is functioning. If the "SYNC" LED is on continue to the next step.
- 3.) If the Emergency Insulated Case Switch remains open verify that the "CE" LED on the main control board is on. If the "CE" LED is not on , the main control board has failed. If the "CE" LED is on continue to the next step.
- 4.) Verify that the CE relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CE relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:
  - a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the generator input terminals and this Relay Interface board.
  - b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "CE" relay is not closed. Check for DC voltage across D4.
    - (1) If there is no voltage on D4, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 17. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 17. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D4, the relay interface board

has failed. If there is nominal DC voltage across D4, continue to the next step.

- (2) Verify that the "CE" relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place an Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay. If there is still no continuity, the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the CE relay on the Relay Interface Board. This should resolve the problem.

- c.) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the emergency switch close coil A1 & A4 and the wiring between the Relay Interface Board and the transfer motor.

- d.) NORMAL FAILS TO OPEN – (CLOSED TRANSITION)

Same as 4B – Normal Fails to open – (open transition)

### **7.3 AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO NORMAL**

- 1) Check for proper voltage on the utility input. This should be measured at the input terminals to the Automatic Transfer Switch NL1, NL2, and NL3. If the voltage of the utility is incorrect, contact the local utility company. If the utility has the proper output voltage continue to the next step.
- 2) Check to see that the Phase Failure Relay (PFRN) is energized. The PFRN has a red LED to indicate that it is energized. If not energized review connections from generator input to the PFRN relay. If energized continue to next step.
- 3) Look at the diagnostic LED's on the main controller board. Verify that the LED labeled "NOR" (Normal On Relay) is on.
  - a) If the LED is not on, either the PFRN has a failed output contact or the main control board has failed. To determine what has failed, place a jumper on the main control board from terminal "input return" to "NOR". If the "NOR" LED turns on, the PFRN output contact has failed. If the "NOR" LED remains off, the main control board has failed.
  - b) If the LED is on, continue to the next step.

- 4) Check to see that the switches have been given a signal to open and close. This step varies between an open transition and closed transition switch.

An Insulated Case Transfer Switch has two stages to transfer to normal. First emergency must open and secondly, normal must close. For Closed Transition, normal must close first, and then Emergency must open.

a) EMERGENCY FAILS TO OPEN – OPEN TRANSITION

- 1) For an IC Automatic Transfer Switch "OE" (open emergency) will begin the transfer to normal. If the Emergency Insulated Case Switch remains closed verify that the "OE" LED on the main control board is on. If the "OE" LED is not on, the main control board has failed. If the "OE" LED is on continue to the next step.
- 2) Verify that the "OE" relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the "OE" relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:
  - a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the utility input terminals and this Relay Interface board.
  - b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "OE" relay is not closed. Check for DC voltage across D2.
    - (1) If there is no voltage on D2, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 18. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 18. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D2, the relay interface board has failed. If there is nominal DC voltage across D2, continue to the next step.
    - (2) Verify that the "OE" relay is functioning. Remove the wires from C and NO for the ON relay on the Relay Interface Board. Place an Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay. If

there is still no continuity, the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the OE relay on the Relay Interface Board. This should resolve the problem.

- c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the emergency switch open coil C1 & C2 (or the dc open emergency relay if used) and the wiring between the Relay Interface Board and the emergency transfer motor.
- b.) NORMAL FAILS TO CLOSE – (OPEN TRANSITION)
- 1) For a Style III Automatic Transfer Switch "CN" (close normal) will complete the transfer to normal. If the Normal Insulated Case Switch remains open verify that the "CN" LED on the main control board is on. If the "CN" LED is not on, the main control board has failed. If the "CN" LED is on continue to the next step.
  - 2) Verify that the CN relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CN relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:
    - a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the utility input terminals and this Relay Interface board.
    - b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "CN" relay is not closed. Check for DC voltage across D3.
      - (1) If there is no voltage on D3, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 19. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 19. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D3, the relay interface board has failed. If there is nominal DC voltage across D3, continue to the next step.

(2) Verify that the "CN" relay is functioning. Remove the wires from C and NO for the CE relay on the Relay Interface Board. Place an Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay. If there is still no continuity, the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the CN relay on the Relay Interface Board. This should resolve the problem.

c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the normal switch close coil A1 & A4 and the wiring between the Relay Interface Board and the transfer motor.

c.) NORMAL FAILS TO CLOSE – (CLOSED TRANSITION)

- 1) For an IC Automatic Transfer Switch with Closed transition option and both sources available, the "AS" (activate synchronization) LED on the main control board must be on. If the "AS" LED is not on, the main control board has failed. If the "AS" LED is on, continue to the next step.
- 2) Once the normal and emergency source are in sync, the synchronizing device closes its contact lighting up the "SYNC" LED on the main control board. If this LED is not lit, the two sources are not in sync, the synchronizer is not functioning and/or the main control board has failed. To verify it is not the control board, remove the "CN" (close normal) relay from the relay interface board to prevent the normal insulated case switch from closing out of phase and then place a jumper across terminals "input return" and "sync" on the main control board. The "SYNC" LED should light indicating that the main control board is functioning. If the "SYNC" LED is on continue to the next step.
- 3) If the Normal Insulated Case Switch remains open verify that the "CN" LED on the main control board is on. If the "CN" LED is not on, the main control board has failed. If the "CN" LED is on continue to the next step.
- 4) Verify that the CN relay on the Relay Interface Board is working by measuring 120VAC nominally at the "C" and "NO" terminals of the CN relay on the Relay Interface Board to common – (common is wire 100, or neutral). There are three possibilities:

- a) 120 VAC voltage is not available on "C" or "NO". This indicates that power is not getting to the Relay Interface Board. Check the wiring between the utility input terminals and this Relay Interface board.
- b) 120 VAC is only available on the "C" or "NO" terminal but not both. This indicates that the "CN" relay is not closed. Check for DC voltage across D3.
  - (1) If there is no voltage on D3, the main controller board, ribbon cable, and/or the relay interface board have failed. To determine which component has failed, this signal needs to be traced. This signal leaves the main controller board on connector J4 pin 19. If voltage is not present on this pin, the main controller board has failed. The signal travels through the ribbon cable and arrives on the relay interface board on J1 pin 19. If voltage is not present on this pin of the ribbon cable, the ribbon cable has failed. If voltage is present on this pin but not across D3, the relay interface board has failed. If there is nominal DC voltage across D3, continue to the next step.
  - (2) Verify that the "CN" relay is functioning. Remove the wires from C and NO for the CN relay on the Relay Interface Board. Place an Ohmmeter or continuity checker across these terminals and verify continuity. If there is no continuity here, either the relay has failed or the Relay Interface Board has failed. The easiest method to check this is to replace the relay, if there is still no continuity; the Relay Interface Board has failed. If there is continuity here, the relay was bad. Now reconnect the wires from C and NO for the CN relay on the Relay Interface Board. This should resolve the problem.
- c) 120 VAC is available on both "C" and "NO" terminals. This indicates that power is getting through the Relay Interface Board. Check the voltage on the normal switch close coil A1 & A4 and the wiring between the Relay Interface Board and the transfer motor.
- d.) EMERGENCY FAILS TO OPEN – (CLOSED TRANSITION)  
 Same as 4B – Emergency fails to open – (open transition)

## 8. OPTIONAL ACCESSORIES

Lake Shore Electric offers many additional accessories for the style 2 and style 3 transfer switches. Please check the documents and drawings for your particular switch to see what additional options are included.

### 8.1. Service Entrance

This option provides for the Automatic Transfer Switch to be labeled as suitable for use as service equipment. The Actual determination of designating it as service equipment rests with the engineer in charge of the project or the authority having jurisdiction. When the Service Entrance accessory is selected, the Transfer Switch is suitable for use as Service Entrance Equipment and is provided with the following additional equipment:

- Pad lockable Enclosure
- Over Current Trip and Bell Alarm for the Service Disconnect
- LED indication of source "Tripped".
- A means to disable the HMI keypad
- Neutral bus with main and ground lugs.
- Main bonding jumper per NEC 2002 250.8.
- Appropriate nameplates and instructions to be applied in the field.

Instructions and labeling that accompanies the service entrance transfer switch will be in the following format.

1. When required by the National Electric Code or the engineer in charge of the project, connect one side of the grounding strap that is presently mounted on the neutral bar to ground. The other side of the grounding strap will remain connected to the neutral bar.
2. Apply the "SERVICE DISCONNECT" label on or near the operating handle of the Normal circuit breakers as required per the National Electrical Code or the engineer in charge of the project.
3. Apply the "SERVICE ENTRANCE" label on the outside of the enclosure door above the door handle.
4. If the building is supplied by more than one service, a permanent plaque or directory should be installed at this service disconnect denoting the location of all other services, feeders and branch circuits supplying this building in accordance with 2002 NEC 230-2.E.

### SERVICE ENTRANCE

1. Place Operating Mode of HMI to "Off/Reset".
2. Unlock and open the enclosure door.
3. Place the "Menu System Enable" switch in the "Disabled" position.
4. Depress any pad on the HMI to verify that → Keypad Disabled ← is displayed.
5. Place the service disconnect switch in the OFF or OPEN position.
6. Open the fused disconnect for F1, F2, and F3.
7. Close and lock the enclosure door.
8. Reverse the above procedure to place the equipment back in service.

SERVICE ENTRANCE LABEL

## 8.2 Ground Fault Protection or Indication

This option provides ground fault detection on the load bus of the transfer switch. Once the ground fault is detected, the switch can be factory configured to provide either **protection** or **indication**.

**Ground fault protection** means that the "GROUND FAULT" LED will light, the source connected to the load will be opened, the switch will be automatically placed in the Fault Mode and the HMI LCD will display:

**FAULT – Ground Fault**  
**08:24 Fri OCT 4, 2002**

**Ground fault indication** means that the "GROUND FAULT" LED will light, however the operation of the transfer switch will not be interrupted and the mode of operation will not be changed.

## 8.3 Pre-Transfer Signal

This option provides an additional timer, TDBT Time Delay Before Transfer. This timer is adjustable from 0 to 300 seconds and is factory set at 10 seconds. It is initiated when the switch is ready to transfer and upon its completion, the transfer will take place. This is typically used in elevator circuits, but can be used in other applications where motor disconnection before transfer is desirable. This timer is not initiated wherever there is a failure of either power source, since its implementation would only serve to delay a transfer to the available source.

While this timer is timing out, its status will be displayed on the HMI LCD display.

<p><b>AUTO – EXERCEISE W/LOAD</b> <b>Awaiting TDBT: 4 sec</b></p>
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Two form “C” contacts are provided on the Relay Interface Board and labeled EC.

#### **8.4 Surge Suppression TVSS**

This option provides hard-wired secondary surge arrestors on both the normal and emergency sources. This provides a degree of protection for voltage surges and lightning strikes. They are suitable for use in service entrance locations and meet the requirements of NEC 280, UL 1449 and ANSI C62.11. They protect surges up to 40 kA/Phase. No field installation is necessary.

#### **8.5 Shunt Trips**

This option provides a shunt trip input to the transfer switch so that from a remote location either or both of the switches can be tripped and the transfer switch sent to the Fault mode. Customer interconnection can be made at TB1.

#### **8.6 Circuit Breaker Trips**

This option provides circuit breaker trips on either or both sides of the transfer switch. Trips will come complete will bell alarms and when tripped, the appropriate light will be illuminated on the HMI.

#### **8.7 Source Available Auxiliary Contacts**

This option provides two form “C” contact output on the Relay Interface Board for customer use. They are identified as “EMR” (Emergency Available) and “NOR” (Normal Available).

#### **8.8 Maintain Load Test Switch**

This option replaces the standard momentary Load Test Switch with a maintained switch. The option also comes with a parallel terminal block connection for remote connection.

#### **8.9 Load Demand Inhibit**

This option provides an input to the transfer switch, which forces transfer from emergency to normal (or neutral if normal is not available) and prohibits the transfer to emergency when normal is not available. This option is used in conjunction with load demand control in associated Lake Shore Electric Paralleling

Switchgear. The input is a two-wire connection on the Relay Interface Board and is marked "LDI".

### 8.10 Peak Shave

This option provides a terminal block input, which will initiate a transfer of the load to emergency. Should emergency fail, the switch will return to normal. This is typically used in conjunction with peak shaving Lake Shore Electric Paralleling Switchgear. The input is a two-wire connection to terminal blocks marked "PS".

### 8.11 Manual Return to Normal

This option eliminates the "TDR" Time Delay to Return timer. In its place a switch and a parallel terminal block are provided. When equipped with this option, the transfer switch will never return to the normal source unless the return is initiated by the depressing of the switch or closing of the remote contacts. The input is only momentary (Between .5 and 1.0 seconds).

### 8.12 Closed Transition Transfer

This option provides for a closed transition (make before break) transfer from normal to emergency when both sources are available and a closed transition transfer from emergency to normal to complete the transfer cycle.

Included with this option is a timer "SFT" synchronize fail timer. This timer when timing will be displayed on the HMI LCD as show here.

**AUTO – EXERCISE W/LOAD  
Awaiting synchronization**

Should the timer time out before the transfer is made, the HMI display will show the following and the trouble contacts will change state. This is not considered a fault mode; therefore the automatic operation of the transfer switch will not be terminated. However, as long as both sources are available, and the synchronizer has detected a match in the phase angles of those two sources, the transfer will not be completed.

**AUTO – EXERCISE W/LOAD  
TROUBLE: SFT timed out**

As a safeguard, the Closed Transition Transfer Option not only a synchronizer, but also a reverse power relay for each source. In the event that both sources might be left in the closed position because of some malfunction, the reverse power relays will sense an unauthorized flow of power and trip and cross trip both sources. This will place the transfer switch in a fault condition and energize the trouble relay. The HMI panels will then display the following along with the appropriate reverse power pilot light.

**FAULT – Reverse Power**  
**08:24 Fri OCT 4, 2002**

## 9. APPENDIXES

### APPENDIX A

#### **\*FIELD CABLE SIZE & LUG TORQUE REQUIREMENTS USE COPPER WIRE ONLY LINE-LOAD-NEUTRAL**

#### **REQUIRED MAINTENANCE**

The following cable lug torque values are required to be checked every six months in order to maintain the Lake Shore Electric Corporation exclusive "one-year" warranty.

<u>ATS SIZE</u>	<u>TORQUE LB-IN.</u>	<u>(HOLES) CABLE RANGE</u>	
800 - 1200	375	4	500MCM - 800MCM
1600 - 2000	375	6	300MCM - 750MCM
2500 - 3000	375	8	500MCM - 800MCM
4000	375	12	500MCM - 800MCM
GROUND	275	1	#6 - 250 MCM

\*Per UL 1008